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Effects and response of dual phase extraction (DPE) remediation on the former Sun City Soco gas station

Travis Winter Meier

EFFECTS AND RESPONSE OF DUAL PHASE EXTRACTION (DPE) REMEDIATION ON THE FORMER SUN CITY SOCO GAS STATION

A Project

Presented to the

Faculty of

California State University,

San Bernardino

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

in

Environmental Sciences

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Approved by:

[redacted]

Dr. Erik Melchiorre, Chair, Geological Sciences — 27Aug08 Date

[redacted]

Dr. Pat McInturff, Management

[redacted]

Dr. James Noblet, Chemistry

ABSTRACT

The former Sun City SoCo is a site that has been experienced contamination due the previous use of the land as a gasoline fueling station. Environmental monitoring and remediation of the site has been performed since 1998 with continuing soil and groundwater contamination existing at the site. The source of the remaining contamination is believed to be in the capillary fringe and smear zone areas where fluctuations in groundwater elevations contract and spread residual hydrocarbon contamination. The ultimate goal of the project was to improve the quality of groundwater underlying the site through the removal residual soil contamination.

In an attempt to eliminate source area contamination, dual-phase extraction (DPE) remediation was implemented through three separate phases at the site. DPE remediation combines common soil vapor extraction (SVE) and groundwater extraction techniques to actively remediate capillary fringe and smear zone contamination by lowering groundwater elevations to allow for extraction of previously submerged or saturated soils through the application of SVE. The progress of the extraction of volatile compounds from the capillary fringe and smear zone was monitored through

weekly vapor sampling of the attached wells in addition to wells surrounding those targeted for DPE in which SVE remediation was applied. Concentrations of detected compounds were multiplied by a measured flow rate and converted to weekly extracted amounts (pounds) per well per compound. Groundwater quality within wells at the site were monitored quarterly over a years period to identify detectable contamination trends prior, concurrently, and following the application of DPE remediation.

Overall, DPE remediation at the site resulted in the extraction of approximately 487 pounds of hydrocarbon vapors and 41,400 gallons of hydrocarbon impacted groundwater. The wells utilized during Phase III of the project (MW-10A, MW-21A, and MW-23A) proved to be the most productive in terms of the poundage of hydrocarbon vapor extracted with SVE and the amount of water extracted during the phase. A comparison of the vapor concentrations (in parts-per-million) extracted from the wells through DPE remediation and the concentration of former SVE samples reveal that DPE is successful in partial remediation of soils previously unattainable due to elevated groundwater levels.

ACKNOWLEDGEMENTS

This project was completed in conjunction with work performed through my employer, R M Environmental, Inc., (RME). Portions of the work used in this project were performed by RME employees other than myself and were relied upon for information provided for this project. Background information, historical site data, and tabulated results were produced by, or in association with, RME documentation and are presented as portions of this project. I would like to thank my fellow employees at RME and members of my graduate advisory committee for providing the time and effort required for the completion of this project. In particular, I would like to recognize the contributions of Mr. Robert Manning; CEG, Ms. Nancy McFadden, and Mr. Andrew Coleman through their work at RME.

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CHAPTER ONE

INTRODUCTION

Dual phase Extraction (DPE) is a process that involves the removal of hydrocarbon contamination in both the vapor and groundwater of a site through the use of groundwater pumps and the application of a high vacuum to subsurface soils. The main purpose in utilizing DPE at a site is to eliminate source zones of continued groundwater contamination that generally reside in submerged, or semi-submerged, soils beneath the site. The targeted soil is typically located within the range of fluctuation of the groundwater table and may be submerged at times due to a rapid increase in groundwater elevation. Intensive monitoring of changing site conditions in response to the application of DPE is required for the extent of the remediation process and determines the effectiveness of the DPE system. A detailed description of the limited application of DPE at a site in Riverside County, California is described below.

Historical Site Information

The former Sun City Spartan Oil Company (SoCo) gas station site consists of many complex and problematic geologic and hydrogeologic situations. The historical use of the site as a commercial gas station resulted in at least two separate unauthorized releases of unleaded gasoline to the underlying soils and groundwater aquifers. The extent of the hydrocarbon contamination resulting from the releases has been determined through the installation of twenty-six groundwater monitoring wells and two soil vapor extraction (SVE) wells. Groundwater contamination has been determined to extend to the upper unconfined groundwater aquifer underlying the site at approximately 28 feet below ground surface (bgs) and has recently extended to a deeper aquifer (approximately 40 feet bgs) to a lesser extent.

Currently, large amounts of total petroleum hydrocarbons as gasoline (TPH-g), benzene, toluene, ethylbenzene, xylenes (BTEX), and fuel oxygenates such as MTBE and TBA are present throughout the site. Further complicating the ongoing evaluation of the site is the presence of two additional leaking underground storage tank (LUST) sites on adjoining properties and one additional

LUST site approximately 200 feet northwest of the former Sun City SoCo site. Groundwater within the vicinity of the sites has historically shown varying directions, flow rates, and wetted depths leaving the exact extent of each of the separate LUST releases in constant dispute.

Background

The former Sun City SoCo station (Site) is located at 26771 McCall Boulevard, Sun City, California. A location map of the site is presented as Figure 1 - Site Location Map in Appendix A - Figures.

Historically, the site consisted of undeveloped property prior to the development of the SoCo station sometime between 1962 and 1974. Operation of the gas station occurred from the initial time of construction through 1991, when the SoCo station shutdown. In 2003, the site was redeveloped into a Walgreens drugstore, which currently occupies the property.

The Site consisted of a commercial gas station with one 6,000-gallon and one 10,000-gallon gasoline underground storage tank (UST), one 8,000-gallon diesel UST with two dispenser islands and associated piping.

In August 1989, a faulty underground fuel pipe created an unauthorized gasoline release in the vicinity of the

north end of the eastern fuel dispenser at the Site. In response the fuel pipe was repaired in December 1989, and approximately 65 cubic yards of soil was excavated from the area, treated, and disposed of under the supervision of Petroleum Industry Consultants (PIC) and with the approval of the County of Riverside Department of Environmental Health (CRDEH).

Further investigation of the spill by way of the installation of groundwater monitoring well MW-1 was requested by CRDEH. In January 1990, groundwater well MW-1 was installed by PIC to a depth of 35 feet below the ground surface (bgs) where a resistant clay layer was encountered. The clay layer was identified as a potential aquitard and was not penetrated in order to prevent further horizontal migration of hydrocarbon contamination. Samples collected from the encountered groundwater at 30 feet bgs indicated elevated TPH-g and BTEX compounds.

In December 1990, Underground Tank Management, Inc., was retained to perform a site assessment investigation of the former Sun City SoCo. The work performed as part of the investigation included the installation and monitoring of groundwater monitoring wells MW-2 through MW-4. Groundwater monitoring wells MW-2 through MW-4 were all screened from

23 to 40 feet bgs utilizing 4-inch PVC casing with 0.020-inch slotted screen. Measurements indicated hydrocarbon free-product, a layer of petroleum liquid that is lighter than water and therefore floats on groundwater, was present in wells MW-1 through MW-4 at thickness varying from 0.01 to 0.49 feet and depth to groundwater ranging from 28.33 to 34.11 feet bgs. Due to the presence of hydrocarbon free-product in the wells, groundwater samples were not collected.

Between May and June 1999, all three UST's, fuel dispensing piping, and fuel dispensers were removed from the site due to the closure of the SoCo gas station in 1991. Following removal of the USTs, soil samples were collected from the bottom of the UST excavation, and in the vicinity of the former fuel dispensers and piping. The collected soil samples indicated elevated hydrocarbon concentrations from all of the sampling locations.

In June 1999, additional exaction and soil sampling was conducted in the area of the former USTs. Soil excavation extended to depths of 14 to 15 feet bgs. All excavated soil was transported off-site for remediation and disposal. The UST excavation was backfilled with fill soil provided from a "clean" site.

Between November 1999 and February 2000, R M Environmental (RME) performed six exploratory borings (B-1 through B-6) and installed five groundwater monitoring wells (MW-5 through MW-9). Findings of the investigation included the following:

- Elevated concentrations of MTBE were detected at depths of 5 to 30 feet bgs in the borings conducted in the former UST area. No other significant hydrocarbon compounds were detected in the soil samples collected from the former UST area.
- Elevated concentrations of TPH-g, BTEX, and MTBE compounds were detected at depths of 25 to 35 feet bgs in the area of the former eastern fuel dispensers. No significant hydrocarbon concentrations were detected in the area of the northern fuel dispensers.
- Groundwater underlying the site was measured at depths of 29.93 to 36.70 feet bgs in wells MW-1 through MW-4, and from 38.25 to 46.75 feet bgs in wells MW-5, MW-6, MW-8, and MW-9. Groundwater well MW-7 was measured dry to a depth of 44.90 feet bgs.

- Information from encountered soils in borings B-1 through B-6 and the measured groundwater elevations of the wells at the site, two separate shallow groundwater aquifers were identified beneath the site. The upper aquifer was determined to be present in wells MW-1 through MW-4 with a gradient toward the southwest; the lower aquifer was determined to be present in wells MW-6, MW-8, and MW-9, with a gradient toward the west.
- Hydrocarbon free-product was measured in well MW-3 at a thickness of 2.64-inches.
- The upper aquifer was determined to be a discontinuous perched groundwater zone. (RME, December 2006, p. 3)

In May and June 2000, RME drilled and installed soil vapor extraction (SVE) wells SVE-1 and SVE-2 within the vicinity of the former USTs and the eastern fuel dispensers, respectively. Elevated MTBE concentrations were detected in the soil samples collected from the installation of well SVE-1. Minor MTBE and BTEX compound concentrations were detected in the soil samples from well SVE-2. Wells SVE-1

and SVE-2 were both screened at depths from 13 to 33 feet bgs.

A SVE pilot-test utilizing wells SVE-1 and SVE-2 indicated SVE remediation at the site was a viable remedial method. The effective radius of influence, using an induced vacuum of 80-inches waster and a flow rate of 30 cubic feet per minute, was recorded as 65 feet. A noted reduction of recovered hydrocarbons was observed when the induced vacuum was reduced from 80 to 39-inches water.

In September 2000, RME drilled and continuously sampled exploratory borings B-7 through B-14. Exploratory borings B-10 through B-14 were converted in groundwater monitoring wells MW-10 through MW-14, respectively. Wells MW-10A and MW-13A were installed adjacent to deep aquifer wells MW-10 and MW-13, respectively. Findings of the investigation included:

- The geology encountered consisted of "an older soil horizon comprised of . . . stiff to very stiff, clayey sand and clayey silt" within the upper 5 to 8 feet. This layer is underlain by "dense to very dense, fine to medium grained sands to depths of

approximately 31 to 34 feet bgs." Beneath the sand layer was a "very stiff to hard, sandy silt and silt to depths of approximately 36 to 40 feet bgs which is underlain by dense to very dense, fine to medium grained interbedded sands and silts to the maximum depth explored of 61.5 feet bgs." It was concluded that the two silt and sandy silt zones present at the site were acting aquitards and separating the upper and lower aquifers at the site.

- Elevated soil concentrations of MTBE were detected from 21 to 32 feet bgs in monitoring well MW-12. Elevated concentrations of TPH-g were detected in boring/monitoring well MW-13 at the capillary fringe (28 feet bgs) and in MW-14 (46 feet bgs). No significant amount of BTEX compounds was detected in the soil samples. (RME, December 2006, p.3-4)

In March 2001, groundwater monitoring wells MW-8 and MW-9 were abandoned in order to prevent cross contamination of the two aquifers located beneath the site. The possible contamination was identified as a problem due to the screening of the wells extending through both underlying

aquifers. Groundwater monitoring well MW-3 was also abandoned in preparation for future development of the site into a Walgreens drugstore. Groundwater well MW-9 was replaced by wells MW-9A and MW-9B installed into the upper and lower aquifers, respectively.

Between December 2002 and January 2003, RME installed wells MW-17, MW-17A, MW-21A, and MW-23A at the site. Groundwater well MW-17 was installed to monitor the lower aquifer; the remaining wells were installed to further delineate the upper aquifer. MW-17A was installed as an upper aquifer monitoring well adjacent to the lower counterpart MW-17. MTBE and TBA were detected in the soil samples collected from both groundwater wells MW-17 and MW-17A.

In February 2003, RME abandoned groundwater well MW-5 in order to allow the site to be developed into a Walgreens drugstore. During the construction of the store the upper seven feet of soils in the building pad area were excavated and re-compacted and all wells on-site were finished with new wellheads. The construction also provided the opportunity for the connection of all upper aquifer groundwater wells (except MW-13A) to piping laterals running to a newly constructed compound for SVE operation

(remediation compound). The well laterals were raised above the finish grade and aligned to allow for future connection to a SVE unit. In May 2003, groundwater monitoring well MW-5R was installed as a replacement for the abandoned well MW-5.

From December 2003 through December 2004, SVE remediation was conducted on-site. The SVE system consisted of a 300 SCFM (standard cubic feet per minute) soil vapor extraction unit connected to well SVE-1, SVE-2, MW-1, MW-2, MW-4, MW-5R, MW-9A, MW-10A, MW-12, MW-17A, MW-21A, and MW-23A. SVE remediation was discontinued due to vapor concentrations from the connected wells reaching asymptotic levels in the final weeks of operation. The recovered amount of TPH-g, BTEX, and MTBE compounds during the SVE remediation are as follows; 3,684 pounds of TPH-g, 7.8 pounds of benzene, 117.7 pounds of toluene, 66.6 pounds of ethylene, 727.8 pounds of xylenes, and 98.9 pounds of MTBE.

Between October 2005 and May 2007, RME installed, developed, and sampled groundwater monitoring wells Mw-15A, MW-16A, MW-18A, MW-19A, MW-20A, MW-24A, and MW-25A on the adjacent roads and properties to help further delineate the extent of contamination present if the upper aquifer underlying the site.

Currently, a total of twenty-six groundwater monitoring wells and two soil vapor extraction wells are present on the subject site and the adjacent properties. A site plan showing all prior and current groundwater monitoring wells, structures, and SVE wells is presented in Appendix A - Figures, of this report as Figure 2 - Site Plan.

Quarterly groundwater monitoring has been conducted at the site by RME from November 1999 to the present time. Significant TPH-g and BTEX compounds appear to be present throughout the site and significant MTBE concentrations are present in the southeast portion of the site (wells MW-1, MW-2, MW-5R, MW-6A, MW-9A, MW-12, and MW-17A). All compounds have shown large decreases in concentration since the initial monitoring event with the exception of tert-butyl alcohol (TBA) and MTBE compounds in several wells.

Site Geology

The site is located in the central portion of the Perris Block of the Peninsular Range Geomorphic Province of southern California. (USGS, Romoland Quadrangle Map, 1979) Uplift and lateral displacement have occurred on a series of northwest trending faults, which are related to the regional tectonic framework. Some of these faults have

remained active to the present time, which include the San Jacinto Fault zone located approximately sixteen miles to the northeast, the Casa Loma Fault zone located approximately 12 miles to the northeast, and the Elsinore Fault zone (Wildomar branch) located approximately 7 miles to the southwest. No known faults exist on or project into the site. (CDC, Alquist-Priolo Digital Maps, 2000)

Locally, the site is underlain by 5 to 8 feet of and older soil horizon composed of dark-brown to reddish brown, stiff to very stiff, clayey sand and clayey silt, which is underlain by fine to medium grained, dense to very dense sands to depths of approximately 31 to 34 feet bgs. This is underlain by a 2 to 6 feet thick zone of very stiff to hard, sandy silt to silt. This silt zone has restricted the downward movement of groundwater, which has created an upper-perched groundwater zone at depths of 28 to 33 feet bgs. Below the silt deposits, are layers of dense to very dense, fine to medium grained, interbedded sands and silts, which extend to the maximum depth explored of 61.5 feet bgs. (RME, December 2006, p. 6)

For the work performed in conjunction with this project, the site was divided into three separate phases, Phase I through Phase III, for the targeting of remediation

of hydrocarbon compounds within each area. The phases are identified as Phase I (MW-5R, MW-11, MW-12, SVE-1) located in the southeast portion of the site, Phase II (MW-1, MW-2, MW-9A, MW-17A) located in the eastern portion of the site, and Phase III (MW-10A, MW-21A, MW-23A) located on the western border of the site. Geologic cross-sections of the wells included in Phase I through Phase III are presented as Figures 3 through 5, respectively, in Appendix A - Figures.

Site Hydrogeology

The site is located in the south-central portion of the Perris South II Subbasin of the West San Jacinto Groundwater Basin. (EMWD, June 1999) and has been identified to contain at least two shallow groundwater aquifers beneath the subject and adjacent properties.

The upper or shallow aquifer consists of thin layered, discontinuous sand lenses identified within monitoring wells MW-1, MW-2, MW-4, MW-6A, MW-9A, MW-10A, MW-11, MW-12, MW-13A, MW-15A through MW-19A, MW-21A, MW-23A, and MW-25A. The upper or shallow groundwater layer was measured at depths of 25.25 to 29.96 feet below the top of well casing elevations on January 10, 2008. (RME, January 2008) Groundwater elevations in the shallow aquifer have varied

greatly within the last year with elevations dropping from 0.30 to 1.03 feet throughout the site and adjacent properties. Groundwater wells MW-15A and MW-16A located on the property located west to the subject site have experienced decreases in groundwater elevations of over 5.44 and 1.75 feet, respectively. The large decrease in elevation is believed to be related to the presence of very small water bearing sand lenses within the vicinity of the wells. As a result, a slight decrease in the groundwater level within the lenses eliminates the source of water supplying the wells and creates an apparent dramatic drop in the groundwater elevation. Groundwater levels within well MW-15A show a prime example of this situation with groundwater levels originating at approximately 27 feet bgs in June 2006 and dropping to over 34 feet bgs (total well depth) in January 2008. Groundwater flow within the upper or shallow aquifer has shown varied flow directions and gradients ranging from 0.013 to 0.056 ft/ft.

The lower or deep aquifer consists of a semi-confined zone of thinly bedded sands underlain by a confining aquitard of clays and sands. The deep aquifer has been identified as being present in monitoring wells MW-7, MW-9B, MW-10, MW-13, MW-14, and MW-17. The lower/deep aquifer

was measured at depths of 43.24 to 44.24 feet below the top of well casing elevations on January 10, 2008. Groundwater elevations in the deep aquifer have varied slightly within the last year with elevations dropping from 2.19 to 2.33 feet throughout the site. Groundwater equipotential elevation contours using the information collected on January 10, 2008, within the lower/deep aquifer indicated a flow direction toward the northwest at a gradient of 0.005 ft/ft. (RME, January 2008)

Well screening intervals varying depending on first encountered groundwater during the installation of the well, the purpose of the well, and what information is provided prior to the installation of the well. Groundwater well installations of wells MW-6 and MW-7 were performed to the first apparent groundwater, which was anticipated at 45 feet bgs during the installation. The wells were screened from approximately 21 to 46 feet bgs. Between February 2000 and September 2003, groundwater well MW-7 was measured dry. After an apparent rise in the groundwater elevation in the lower or deep aquifer underlying the site, groundwater has been present in the well at depths varying from approximately 40 to 43 feet bgs. The absence of a source of groundwater from the upper or shallow aquifer in the well

indicates that the aquifer is present in discontinuous layers throughout the site and adjacent properties. Groundwater well MW-6 also displayed peculiar trends with initial groundwater levels varying from 40 feet to over 45 feet (dry well) bgs. After the site was redeveloped as a Walgreens drugstore in January 2004, groundwater levels within MW-6 were measured at levels indicative of the upper or shallow groundwater aquifer (27 to 32 feet bgs). The collective agreement between myself and other representatives of RME believe an isolated aquitard layer previously inhibited the change in groundwater elevation within the well.

Recent installations of wells MW-20A and MW-24A on the property adjacent to the west of the subject site were conducted to depths of 34.25 and 35.17 feet bgs, respectively. Both wells have been measured "dry" since their installation. The lack of an upper aquifer within the vicinity of these wells further promotes the notion of discontinuous water-bearing lenses throughout the site and adjoining properties. Groundwater well MW-15A, also located on the property to the west of the subject site, shows similar signs of discontinuous aquifer lenses. Groundwater in well MW-15A (total depth of 35.42 feet) was initially

recorded as being 27.08 feet bgs in June 2006, but the well was recently measured dry during the last quarterly groundwater monitoring event for the site (January 2008). The large decrease in groundwater elevation within the well is also believed to be due to a lesser decrease in groundwater elevation within the water-bearing sand lenses resulting in a drop into an aquitard layer. Consequently, the layer inhibits the flow of groundwater into the well and causes a halt in groundwater within the area.

Overall, groundwater underlying the site and surrounding properties is present in a discontinuous sand lenses which forms the upper aquifer present in various areas of the site and a continuous lower aquifer present throughout the site and adjoining properties. The groundwater within the upper aquifer has no distinct flow direction due to the aquifer shifting constantly through sand lenses throughout the area. The lower aquifer has a flow toward the west-northwest at a gradient of 0.005 ft/ft (RME, January 2008).

Previous Remediation

Soil Vapor Extraction

During the redevelopment of the site into a Walgreens drugstore in 2003, trenching was performed to allow for lateral piping to be run from wells SVE-1, SVE-2, MW-1, MW-2, MW-4, MW-5R, MW-9A, MW-10A, MW-11, MW-12, MW-17A, MW-21A, and MW-23A to a compound area located in the southeast corner of the site. The piping was installed by use of 2-inch poly-vinyl chloride (PVC) lateral lines being connected via PVC tee to the above-mentioned wells. The purpose was to use the groundwater monitoring and soil vapor extraction (SVE) wells already in place to extract hydrocarbon vapors from soils exposed above the underlying groundwater and to also stimulate aerobic circulation within the groundwater zone of the wells further mobilizing hydrocarbon compounds for soil vapor extraction. The wells were then connected to a 300 SCFM (standard cubic feet per minute) soil vapor extraction unit located in the remediation compound on-site. Each line from the individual wells was provided with flow gauges and sampling ports for calculation of detected vapor concentrations.

SVE remediation began at the site in December 2003. Weekly vapor samples were collected from active individual

wells for analysis and to determine which wells were the most productive for hydrocarbon recovery. Isolated areas of the site would then be utilized for the active recovery of hydrocarbon compounds throughout the property. SVE remediation continued at the site for a period of one year and was ended in December 2004. Based on collected vapor samples and flow values from their respective extraction lines, the following amount of hydrocarbon compounds were determined to have been extracted from the site; 3,684 pounds of TPH-g, 7.8 pounds of benzene, 117.7 pounds of toluene, 66.6 pounds of ethylene, 427.8 pounds of xylenes, and 98.9 pounds of MTBE (RME, December 2006, p. 5).

Free-Product Skimmers

Following the removals of the USTs and associated piping and islands in 1999, light non-aqueous phase liquid (LNAPL), or hydrocarbon free-product, was discovered to be present in several recently installed groundwater monitoring wells. Placement of chain-mounted slotted PVC free-product collection devices termed "skimmers" was implemented to recover any floating free-product encountered in groundwater monitoring wells. Prior to the skimmers being placed in a well, depth to groundwater and free-product thickness were measured and used for the

correct placement of skimmers at the groundwater/free-product interface. The skimmers would be emptied periodically depending on production of free-product in the well. The collected free-product would be stored in a 55-gallon drum for proper disposal by a hazardous waste recycling facility off-site. Free-product skimmers were present in various wells at the site from November 1999 through April 2004. The following table shows the maximum thickness and the amount of hydrocarbon free-product recovered from individual wells:

Table 1. Free-Product Thickness and Total Recovered Free-Product Per Well

Well Number	Maximum Product Thickness (feet)	Recovered Free-product (gallons)
MW-1	1.42	7.18
MW-2	0.27	1.11
MW-3	1.65	55.2
MW-4	0.49	1.11
MW-8	0.29	1.61
MW-9	1.18	0.00
MW-9A	0.03	0.01
MW-10A	5.15	151.8

Source: "Remedial Action Plan, Sun City SoCo, 26771 McCall Blvd., Sun City California," prepared by RME, Project No. 98-299.RP-3, December 2006.

Collectively, 825.73 liters of hydrocarbon free-product was recovered from the site between November 1999 and April 2004. Since then only slight hydrocarbon sheens (> 0.01') have been detected at the site during quarterly groundwater monitoring events in wells MW-1, MW-4, MW-9A, MW-10A, MW-12, MW-13A, MW-21A, and MW-23A.

The current status of the site consists of quarterly groundwater monitoring events (January, April, July, September) in which groundwater wells associated with the

site are measured for depth to groundwater and sampled for hydrocarbon contamination. Using this information, contouring of the underlying groundwater flow direction is completed through calculating the groundwater elevations within each well to determine the groundwater flow direction and gradient. Through the groundwater contouring, the migration and extent of hydrocarbon contamination, per individual compound, are approximated using groundwater flow modeling. Information provided by these quarterly groundwater monitoring events provides a collaboration of useful information for design and implementation of potential remediation methods, such as dual phase extraction (DPE).

CHAPTER TWO

DUAL PHASE EXTRACTION REMEDIATION OF THE FORMER SUN CITY SOCO

Project Description

A brief summary of the objectives, importance, and limiting factors for the DPE remediation of the Site are described below.

Purpose of the Project

Elevated hydrocarbon compounds have been determined to be present in both the soil and the groundwater underlying the site. Groundwater contamination that was once present in separate free-product layers floating on the underlying groundwater has since dissolved into groundwater over time and is mainly present in a composite dissolved-phase throughout the upper or shallow groundwater aquifer. Previous SVE remediation and quarterly groundwater monitoring event have identified several areas throughout the site as containing high concentrations of hydrocarbon compounds relative to the surrounding wells. These areas can be identified as three different zones; the former UST area, the eastern portion of the site, and the western portion of the site.

The purpose of this project is to target these three zones for both soil and groundwater remediation. It is the intent that by targeting the source areas of the contamination with remedial processes that consequently the continued introduction and dispersal of the hydrocarbon compounds will be prevented. The remedial methods selected for the project will be evaluated for effectiveness in regard to the specific nature of the site, common alternatives not chosen for the project, limitations encountered during remedial processes, and overall performance and results obtained from the project.

Scope of the Project

The former Sun City SoCo gas station has large amounts of hydrocarbon compounds present in the soil and upper groundwater aquifer located beneath the site. The main focus of this project is for the remediation of three contamination source zones (UST area, eastern portion, western portion) at the site through the application of dual-phase extraction (DPE) remediation. The dual-phase process involves the extraction of groundwater from targeted groundwater monitoring wells via a submersible pump while simultaneously extracting vapors from exposed contaminated soils by connection to a SVE unit. Ideally,

the drop in groundwater elevation resulting from groundwater extraction within a well will create increased exposure of contaminated soils allowing for enhanced vapor recovery from within both the targeted and surrounding wells through SVE remediation.

A pumping rate of approximately 300-gallons of water per well per day was selected, based upon an aquifer test conducted at the site in September 2006. Anticipated drops in groundwater elevation are expected to be between 1 and 4 feet within the pumped wells with an effective radius of influence of approximately 20 lateral feet (RME, December 2006, p. 14). Both the groundwater extraction pumps and SVE unit will continuously operate for a minimum of five weeks with changes in the following weeks depending on the effectiveness of the systems.

Effectiveness was judged based on groundwater measurements and vapor concentrations collected at least once a week from the attached wells. Each of the three phases, Phase I through Phase III, will be planned for a minimum of six weeks of active remediation although extensions in the remediation of a zone can be considered if consistent operational problems are encountered or if vapor recovery results indicate positive extraction rates.

Results of the project will be used to evaluate the effectiveness of DPE as a remediation method for the site as well as to identify any problems encountered. The information gathered during the project will allow for better design of future remedial systems, cost effective analysis of additional sites proposed for remediation, and comparative data for use in conjunction with results obtained from other remediation systems.

Significance of the Project

Determination of the effectiveness and appropriateness of a remedial system for a site has been generally outlined in various sources although interpretation in changing geographic settings, geologic and hydrogeologic conditions, and targeted compounds still present numerous variables for consideration. The use of DPE remediation, although applied at sites for over a decade, continues to be redefined in regard to application, methods used, efficiency, and the specific purpose for the project it is applied to. The application at this project involves the use of previously constructed groundwater monitoring wells as a conduit for groundwater extraction through the use of submersible pneumatic groundwater pumps and SVE by way of PVC laterals connected to a central vapor unit. SVE is the process of

extracting volatile hydrocarbon compounds through a slotted screen section of PVC well in contaminated soils above the groundwater table. An evaluation of the effectiveness of both extraction methods in regard to construction of the utilized wells, operation of the equipment, and varied application of remediation methods will be used to determine if groundwater wells constructed without SVE remediation in mind can effectively be used for vapor remediation. Furthermore, various operational periods for groundwater and vapor extraction will be implemented including full-time operation of both extraction systems, operation of a single extraction system at once, and pulsed operation of both extraction systems conducted for a systematic cycle consisting of various periods of operation.

The information gathered from the dual extraction operations will be utilized to determine if groundwater wells can be effectively utilized for dual extraction remediation, and if so, how the extraction should be conducted to maximize results. The information gathered can prove to be important in regard to both the time and finances required to effectively "clean up" a site through the use of DPE. The significance of this project is to

inform environmental consulting and related businesses of new and increasingly effective remediation methods for properties in similar settings.

Limitations of the Project

Limitations of the project included an allotted time of approximately six weeks of operations within each of the three phases of the project, although slight extensions of time were allowed to accommodate for equipment malfunctions and technical problems encountered. Equipment limitations include the specific use of submersible pneumatic pumps, a 300-PSI air-compressor, and a 200 SCFM (standard cubic feet per minute) soil vapor extraction (SVE) unit for the duration of the project. Furthermore, the effectiveness and overall evaluation of system performance was limited to the specific geographic, geologic, and hydrogeologic conditions present on the subject site and adjoining properties.

Definition of Terms

The following terms, and their associated acronyms, are commonly utilized throughout the project:

Aquitard: Layer of fine-grained soil located beneath a groundwater aquifer that prevents further downward vertical migration

BTEX:	Benzene, toluene, ethylbenzene, and xylenes; volatile organic compounds commonly associated with gasoline contaminated sites
BGS:	Below ground surface
CFM:	Cubic feet per minute
CRDEH:	County of Riverside Department of Environmental Health
DPE:	Dual phase extraction
Free-product:	A layer of petroleum hydrocarbon liquid with a specific gravity less that water, casing it to float atop water surfaces
GPM:	Gallon-per-minute
HDPE:	High Density Poly Ethylene, a plastic substance used in the manufacturing of highly durable containers
Hydrocarbon:	Substances composed only of hydrogen and carbon atoms, associated with petroleum products
LNAPL:	Light, non-aqueous phase liquid; another name for hydrocarbon free-product
LUST:	Leaking underground storage tank

MTBE:	Methyl tert-butyl ether; a gasoline oxygenate with a affinity for water leading to large amounts of groundwater contamination
MW:	Monitoring well
Pilot-test:	Initial testing of a system, commonly SVE, at a site to determine performance and optimal settings depending on geographic settings and conditions
PPM:	Parts-per-million
PSI:	Pounds per square inch; a common measurement of force
PVC:	Poly vinyl chloride; a substance commonly used in the construction of plumbing and other construction materials
RME:	R M Environmental, Inc.; my employer and the company in charge of the project
ROI:	Radius of influence
RWQCB:	Regional Water Quality Control Board
SCAQMD:	South Coast Air Quality Management District

SCFM:	Standard cubic feet per minute; a common measurement of the flow of a substance at standard pressure, temperature, and relative humidity conditions for the location where the measurement is taken
SoCo:	Spartan Oil Company; previous owner of the site and the responsible party for the hydrocarbon contamination requiring remediation
SVE:	Soil vapor extraction
TBA:	Tert-butyl alcohol; a compound created through the degradation of MTBE
TPH-g:	Total Petroleum Hydrocarbons as gasoline; a categorical identification for petroleum hydrocarbons that are located within the gasoline composition range in terms of number of carbon atoms
UST:	Underground storage tank
VOCs:	Volatile organic compounds

CHAPTER THREE

REVIEW OF RELATED LITERATURE

Introduction

The DPE process has been developed and practiced in the environmental consulting field for the last fifteen to twenty years. During that time many different variations and adaptations relating to changing circumstances involved with targeted properties has resulted in numerous methods of DPE. Each of the methods performed involves similar concepts with slightly different applications. The presence of light non-aqueous petroleum liquid (LNAPL), or hydrocarbon free-product, is often the determining factor in which type of DPE is applied to a site.

Dual Phase Extraction Remediation Factors

LNAPL consists of a composition of gasoline and other petroleum hydrocarbons that exhibit a specific gravity less then water; thereby causing the product to accumulate as a floating layer on the underlying groundwater. On most occasions the presence of LNAPL indicates the petroleum release, or at least the final stages of it, has occurred recently (within the last 5-10 years). Although, LNAPL can persist at a site for over a decade (EPA, 1995) due to

fluctuations in the groundwater elevation creating the "smearing" of LNAPL within the area slightly above the groundwater table which is commonly called the capillary fringe.

> DPE can be implemented for remediation of the capillary fringe and smear zone. VOC concentrations are typically highest in capillary fringe soils because of the tendency of LNAPL to accumulate at the water table. Changes in water level move any accumulation of free product on the surface of the water table and create a smear zone of residual contamination. SVE systems are typically ineffective at volatizing contaminants in the capillary fringe and smear zone because of their high water content and low effective air-filled porosity of these soils. In addition, water table upwelling at the point of extraction in an SVE system can submerge residual contamination and prevent removal by the vapor extraction system. (EPA, Selected Enhancements, p. 4-3)

The varying methods of DPE, also commonly referred to as multi-phase extraction, fall into one of two main categories. "DPE technologies can be divided into two general categories, depending on whether subsurface liquid(s) and soil vapor are extracted together as high-velocity dual-phase (liquid(s) and vapor) stream using a single pump or whether the subsurface liquid(s) and soil vapor are extracted separately using two or more pumps."[1] The decision to either use a single pump or two separate pumps for DPE is influenced by several different factors including the geologic and hydrogeologic setting, depth to groundwater, volatility of the targeted compounds, current operations of the site, and budget for the project.

The Sun City SoCo site has several characteristics that point toward the use of two-pump DPE as the technology most suited for the site. The groundwater fluctuations at the site have been limited to a 1 ½ to 2 feet range since monitoring of the levels began (RME, December 2006, Table 1). Although the change in level is not dramatic, fluctuations within the encountered range can prove to be problematic with a single-pump DPE system. "Single-pump DPE

[1] "How to Evaluate Alternative Cleanup technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers: Chapter XI: Dual-Phase Extraction," EPA, May 1995, p. XI-1 to XI-3.

systems are generally better suited to low-permeability conditions, and they are difficult to implement at sites where natural fluctuations in groundwater levels are substantial."[1] Furthermore, the prior operation of a SVE remediation system at the site presents an infrastructure requiring only a simple adaptation for a submersible dual-pump DPE system to be placed in the wells. "Dual-pump DPE systems are simply a combination of traditional soil vapor extraction (SVE) and groundwater (and/or floating product) recovery systems. Dual-pump systems tend to be more flexible than single-pump systems, making dual-pump systems easier to apply over a wider range of site conditions."[1] The use or modification of existing wells for DPE does present a limitation in that the placement of the wells are pre-determined, although the well locations should already be arranged with a focus in the most contaminated zones of the site. The groundwater pumps typically associated with dual-pump systems are submersible and are suspended from a bracket attached to the airtight well cap.

The application of DPE seems to be appropriate at the site as the remedial actions previously used resulted in

the removal of the majority of LNAPL present at the site. "VE/GE systems are used after other free product recovery methods have removed as much mobile product as feasible. Then, and only then, is the water table drawn down to expose the smear zone."[2] Hydrocarbon free-product was actively collected at the site from November 1999 through April 2004 by use of product recovery skimmers placed in wells throughout the site (MW-1 through MW-4, MW-8, MW-9A, and MW-10A). Quarterly groundwater monitoring events conducted since the use of skimmers have indicated non-measurable (<0.01') to slight hydrocarbon sheens (< 0.02') in related wells.

Although DPE technology has been actively used for over a decade, specific criteria for optimal performance of systems are far from established. In fact, many professional opinions about the application of DPE contradict one another in terms of appropriate use of the technology. One area in question is the characteristics of the soil in the targeted area.

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[2] "How to Effectively Recover Free Product At Leaking Underground Storage Tank Sites: A Guide For State Regulators," September 1996, p. V-24

> DPE is most effectively implemented in areas with saturated soils exhibiting moderate to low hydraulic conductivity (silty sands, silts, and clayey silts). Lower permeability soils enable formation of deeper water table cones of depression, exposing more saturated soils and residual contamination to extraction system vapor flow. (EPA, Selected Enhancements, p. 4-4)

A similar situation applies to the geologic setting of the subject project and relates to the Site in that utilizing available soils with lower conductivity will effectively allow for greater depression of the groundwater table when subjected to DPE, however, not all agree on the idea.

> Dual phase vacuum extraction is more effective than SVE for heterogeneous clays and fine sands. However, it is not recommended for lower permeability formations due to the potential to leave isolated lenses of undissolved product in the formation. (Federal Remediation Technologies Roundtable, Remediation Technologies, p. 2)

The targeted soil characteristics issue appears to be one still open for discussion as far as which formations are most effectively targeted.

By looking at two characteristics of the soils located in area targeted for DPE, permeability and volatility, an initial prediction of the effectiveness of DPE can be made. The permeability of the effected soil directly relates to the success in the extraction of vapor and water from the pores of the media. Permeability rates increase from fine-grained soils (clay, silt, clayey silt, etc.) to coarse-grained soils (gravel, sand, etc.). Although application of DPE to various soil types is debatable, the use of DPE can be substantiated through permeability qualities. "Single-pump DPE technology is best suited to sites with intrinsic permeability ranging from 10^-9 to 10^-11cm²… there is no maximum permeability limit for application of dual-pump systems…"[3] Volatility is the rate and conditions at which a material will vaporize or how likely a material is to evaporate. Figure 6, located in Appendix A - Figures,

[3] "How to Evaluate Alternative Cleanup technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers: Chapter XI: Dual-Phase Extraction," EPA, May 1995, p. XI-14

presents a chart displaying the effectiveness of DPE based on these two qualities (EPA, 1995, Exhibit XI-8). The SoCo site can be categorized as containing hydrocarbon contamination within a general layer of silty sand (10^-9 to 10^-6cm² permeability), thereby exhibiting effective to highly effective conditions for dual-pump DPE remediation.

Once a site is determined to contain conditions favorable to DPE remediation the specific parameters of the targeted remediation need to be addressed. One of the most arguable conditions is how much vacuum should be applied to the DPE wells for effective results. The overall goal of DPE is the use of groundwater extraction to lower the water table within a well in order to create a "cone of depression" to allow for greater exposure of the smear zone for SVE remediation. If you separated the two phases of extraction involved with DPE, groundwater and vapor, their respective affects on groundwater elevation can be easily distinguished. Groundwater extraction decreases the static groundwater elevation to the depth the groundwater pump is set while the vacuum associated with SVE displays the opposite affect, raising the groundwater elevation relative to the amount of vacuum (inches water [in. H2O]) applied to the well.

Environmental professionals need to balance the two extraction methods to optimize the performance of the DPE. "High vacuums typically associated with DPE systems enhance both soil vapor and groundwater recovery rates."[4] Although the statement partially valid in that a high vacuums within a well draw both soil vapors and groundwater from greater distances, one major problem can emerge; a well with excessive application of vapor vacuum in coincidence with a inadequately low groundwater extraction rate can result in the raising of the groundwater level within a well.

> Sometimes, the applied vacuum is too great, and the water level within the well casing rises rapidly to a level above the slotted portion of the well casing. When the applied vacuum is too high, no air can be extracted from the subsurface, leading to the erroneous conclusion that DPE cannot be applied at the site. (EPA, A Guide for Corrective Action Plan Reviewers, p. XI-20)

[4] "Analysis of Selected Enhancements for Soil Vapor Extraction," EPA, September 1997, p. 4-1

Consequently, if the groundwater level is elevated above the smear zone in a well, no residual vapor will be able to be extracted. "SVE systems are typically ineffective at volatizing contaminants in the capillary fringe and smear zone because of their high water content and low effective air-filled porosity of these soils. In addition, water table upwelling at the point of extraction in an SVE system can submerge residual contamination and prevent removal by the vapor extraction system."[5] Similar circumstances seem to have been present for the initial period of SVE remediation at the SoCo site. Excessively small amounts of hydrocarbon vapors were recovered in the weekly vapor samples over a period of a year of SVE remediation. The vacuum applied to the wells varied from approximately 20 to 45 inches water according to weekly measurements.

The vacuum may not have been the problem but rather that the smear zone underlying the site was already submerged prior to SVE due to increasing groundwater elevation. The application of DPE was recommended for the site after conducting a successful aquifer test at the SoCo site. Consequently, the purpose of the work performed as

part of the project was to determine if DPE could increase the recoverable amount of hydrocarbon vapors at the site by the lowering of the groundwater table.

Operation of the planned SVE remediation was initially designed for an induced vacuum of 80-inches water per well, although final vacuum settings would depend upon results and operation of the SVE unit. Anticipated groundwater extraction rates (approx. 300 gallon/day/well) with associated decreases in groundwater elevation ranging from 2 to 7 feet within the pumped wells were expected to compliment uprising groundwater levels applied through SVE vacuums.

> DPE enables venting of soil vapors through previously saturated and semi-saturated (capillary fringe) soil by lowering the groundwater table at the point of vapor extraction. High vacuums typically associated with DPE systems enhance both soil vapor and groundwater recovery rates. (EPA, Selected Enhancements, p. 4-5)

The problem can exist that the groundwater pump does not operate as anticipated, resulting in a minimal amount of groundwater being extracted from the well and leaving the smear zone submerged and inaccessible to vapor remediation.

> Less permeable soils generally require higher wellhead vacuum pressures to produce reasonable influence radii of influence. It should be noted, however, that high vacuums can cause upwelling of the water table and occlusion of all or part of the extraction well screens. (EPA, A Guide for Corrective Action Plan Reviewers, p. XI-22)

The design of the DPE system can take form in several different ways. Ideally, if groundwater extraction and SVE remediation have taken place separately at a site, operational data obtained from these experiences can be applied towards the design of the DPE system.

> Generally, the technology required for design and construction of a DPE system is well established and is largely based on experience gained from implementation of separate SVE and groundwater

extraction systems. (EPA, A Guide for Corrective Action Plan Reviewers, p. XI-20)

In the case of the SoCo site there is partial experience from former SVE remediation conducted at the site, but none for groundwater extraction. The parameters used for groundwater extraction were all obtained during an aquifer test of the site to determine if the targeted aquifer could produce enough water for effective remediation.

> To assess the groundwater flow parameters necessary to design the groundwater extraction portion of the DPE system, aquifer testing should be conducted. The use of DPE equipment for vacuum-assisted aquifer testing is desirable, because such testing yields information that is directly relevant to the potential effectiveness of a full-scale DPE system at the site. However, this approach may be prohibitively expensive for smaller sites; in such cases, traditional aquifer testing (using groundwater extraction alone) may be used. (EPA, A Guide for Corrective Action Plan Reviewers, p. XI-20, XI-21)

Performance of an aquifer test consists of the pumping of a groundwater well consistently until steady groundwater elevation conditions are reached to determine the drawn-down within the aquifer. Response in surrounding wells is determined through the measurement of the drawdown within the wells due to the groundwater pumping. Information acquired from the aquifer test includes the transmissivity (sq. feet/day) and the hydraulic conductivity (feet/day) for the subject aquifer.

Current operation of the SoCo site as a Walgreens drugstore presents numerous limitations in regard to the design and implementation of DPE. Additional wells cannot be placed in the middle of the site due the current building and the application of DPE is required to be as minimal a disturbance to the operation of the business as possible. As a result, several key components to the DPE process are unable to be fulfilled.

The number and placement of wells to be utilized is limited to the groundwater wells already in place that have lateral lines run for the application of SVE. These lateral lines were also utilized as conduit for the tubing required for submersible pneumatic groundwater pumps installed in extraction wells. Without such lateral lines DPE would be

limited in application, if not impossible, due to the current status of the site. Understandably, due to the less than ideal conditions of the site during the extent of the project and the utilization of wells previously intended only for monitoring use, maximum DPE results cannot be obtained.

Although typical DPE sites incorporate strategic methodologies utilizing numerous equations to figure the specific configuration of the equipment involved with the site, limitations of equipment availability guided the system specifications used for the SoCo site. A 200 SCFM "Baker" thermal oxidizing SVE unit equipped with vacuum blower was pre-determined for use at the site under consideration that utilized extraction well depth typically ranged from 30 feet bgs and less, thereby allowing for more than enough vacuum to be applied to each well. Groundwater extraction was also pre-determined to be conducted utilizing submersible pneumatic pumps due to higher pumping rates than the alternative, bladder pumps.

Three similar but slightly varied options of DPE are typically considered for application at a site. Drop-tube entrainment extraction, or "bioslurping", is a method where a single tube is lowered into a well and set at the

air/water interface between the vadose and groundwater zones. An applied vacuum to the tube results in the extraction of both air and water through the common tube that are later separated and disposed of according to local criteria. Bioslurping has proven to be an effective remediation technique but is mainly applied to sites targeting LNAPL, not dissolved hydrocarbons and vapor compounds as with the SoCo site. "... this configuration has shown to be effective at free product recovery and is primarily used for that purpose."[5]

The second method of DPE is known as well-screen entrainment which consists of a vacuum being applied to a well screened in both the vadose and groundwater (saturated) zones. Wells designed specifically for use of DPE through well-screen entrainment are generally constructed with 2-inch diameter PVC wells, although 4-inch wells can be utilized with less effective results (EPA, Selected Enhancements, 1997). The main limitation with well-screen entrainment DPE is that the method is not as effective in deep groundwater conditions such as the SoCo site. "This type of DPE is the simplest to implement;

[5] "Multi-Phase Extraction: State-of-the-Practice," EPA, June 1999, p. 7.

however, it may have limited effectiveness for water removal from deep wells. Extraction-well entrainment is most effective at sites with shallow groundwater (less than 10 feet bgs) (Brown and others 1994), but it has been used to depths of approximately 27 feet (Tetra Tech 1996c)."[6]

Conclusions

A dual-pump DPE system was the method chosen for this project due to the potential variability in encountered conditions at the site. Varying geologic and hydrogeologic conditions present throughout the project could result in dramatic changes to the subsurface during the extent of project. "Dual-pump DPE systems are simply a combination of traditional soil vapor extraction (SVE) and groundwater (and/or floating product) recovery systems. Dual-pump systems tend to be more flexible than single-pump systems, making dual-pump systems easier to apply over a wider range of site conditions."[7]

With a SVE infrastructure already present from previous remediation at the SoCo site, dual-pump DPE

[6] "Analysis of Selected Enhancements for Soil Vapor Extraction," EPA, September 1997, p. 4-12

[7] " How to Evaluate Alternative Cleanup technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plant Reviewers: Chapter XI: Dual-Phase Extraction," EPA, May 1995, p. XI-4

utilizing that infrastructure as conduit for the tubing required as part of groundwater extraction was the best option for the project.

CHAPTER FOUR

METHODOLOGY

Site Layout

The DPE extraction conducted at the site was performed through the use of wells targeted through three separate phases (Phase I, Phase II, and Phase III). Each of the phases consisted of pre-existing groundwater monitoring wells and SVE wells connected to a central remediation compound in the southeast portion of the site. Detailed descriptions of the construction, layout, and equipment used for the implementation of the DPE remediation are described below.

Well Construction

Groundwater monitoring wells MW-1, MW-2, MW-9A, MW-10A, MW-11, MW-12, MW-17A, MW-21A, and MW-23A were utilized for either SVE extraction or DPE extraction at various times for the duration of the project. Each of the wells are constructed with 4-inch PVC piping and are screened approximately 10 into the anticipated depth of the upper/shallow aquifer located beneath the site (approximately 20 to 40 feet bgs). Porous Monterey sand (Sand No 3.) was used as water-permeable packing for the

annular space outside the screened portion of the wells and extends 1 to 2 feet above the well screen. The extensive screening of the wells allow for an exposure of 5 to 10 feet of screen in both the groundwater capillary and vadose zones located above the encountered groundwater. Groundwater well MW-5R contains groundwater at a depth of approximately 34 to 36 feet bgs due to the discontinuous dispersion of the upper/shallow groundwater zone at the site.

Each of the groundwater wells utilized was sealed above the sand pack with granular bentonite or bentonite chips to within one foot of the ground surface. The upper one foot of each well are finished with a 12" x 12" locking metal well box set in a concrete pad. Each of the wells is sealed with an airtight screw well cap. A diagram showing the general construction of a groundwater monitoring well is presented as Figure 7 and is included in Appendix A - Figures.

The construction of vapor extraction well SVE-1 consists of 2-inch PVC piping extending to a depth of 33 feet bgs. Slotted well screen (0.010-inch slot) is located from 14 to 33 feet bgs and is packed with Monterey sand in the annular space opposite the well screen to a depth of 2

feet above the screen section. The remaining portion of the well casing consists of blank 2-inch PVC (Schedule 40) to the ground surface. A 2-foot thick granular bentonite seal is used above the filter pack. The remaining annular space of the well is filled with bentonite chips to within one foot of the of the ground surface. The well is finished with an 8 x 8 inch locking metal box set in a concrete pad. An airtight well cap is used to seal the casing. A diagram showing the construction of a standard SVE well is included in Appendix A - Figures, and is presented as Figure 8.

Poly Vinyl Chloride Laterals

Connection of the each of the wells utilized to the Remediation Compound for SVE remediation was achieved through the use of 2-inch PVC laterals. Wells were each connected through individual lateral piping dedicated to a specific well to allow for regulation of wells according to their respective vapor concentrations. The laterals were connected to each of the wells by way of a 2" x 4" reducer bushing connected to a 4-inch tee inserted approximately 2 feet bgs on the wells casing. Each of the laterals was then run to the eastern edge of the remediation compound where the lines were raised approximately six feet, over the

perimeter fencing, and connected to the remedial systems manifold.

Connection of the pneumatic groundwater pumps was also accomplished through running the flexible PVC tubing required for operation in the targeted wells utilizing the PVC laterals as a conduit. Specification of the exact materials used for connection of the pneumatic pumps will be included in the information within the groundwater pump section.

Soil Vapor Extraction Manifold

Construction of the manifold to attach the SVE laterals to the SVE Unit was done through the use of 2-inch flexible rubber couplers allowing for rapid connection and disassembling of the wells associated with Phase I through Phase III. Each of the wells was measured for airflow and induced vacuum within the well lateral byway of an airflow valve (Dwyer Flow Sensor) within an undisturbed portion of the manifold. The vacuum measurement and weekly vapor samples were both collected from a 1/4-inch sampling port installed on the manifold of each individual well. Dilution values were also constructed on the separate piping of each well to allow for adjustments in vacuums applied to

independent wells in accordance with measurement and vapor concentrations.

Groundwater Pumps

The groundwater pumps utilized in selected wells consisted of "Geotech 1.66 Reclaimer Hydrocarbon Recovery System" (pumps) connected to either a "Geotech 1.66 Reclaimer PRS Controller" (Reclaimer) or a "Geotech Geocontroller II Bladder Pump Logic Unit" (Geocontroller) for operation. The controllers allowed for the control of flow rates within each well to a maximum capacity of three gallons per minute (GPM) and for manual settings of pump cycle times in order to optimize recovery from the wells. Pumps were connected to the controller and to the groundwater collection tank through use of 1/4" (inside diameter) Nylobrade PVC tubing, respectively. The tubing was installed in the lateral PVC piping for use during SVE.

Each of the groundwater pumping lines was then separated byway of a 2" tee installed at the raising of the manifold outside the remediation compound. The tubing attached to the associated control box was exposed through air-tight connections while the line carrying the extracted groundwater continued the utilization of 2" PVC piping as a conduit until it reached its final destination, the

groundwater collection tank. A diagram showing the general construction of a DPE well is presented as Figure 9 and is included in Appendix A - Figures. All piping was sealed using airtight connections to allow for maximum SVE recovery without loss to the atmosphere. A schematic of the layout of the DPE system, including flow directions, utilized at the site is presented in Appendix A as Figure 10.

Groundwater pumps were suspended from a wire attached to the well cap and set at a depth approximately ½ to 1-foot from the bottom of each well. Adjustments to the depths the pumps were set at were made in accordance with observations of sediment within the water extracted from a well. Extracted groundwater was stored in a collection tank consisting of a 3,500-gallon HDPE top-fed container. A "Husky" brand 300-PSI air compressor was attached to the controller to provide the positive air pressure required for the pneumatic groundwater pumps.

Groundwater Controller Settings

Pumping rates for each well were set to maximize the amount of water pumped from each well. A maximum flow rate of approximately 300 gallons per day per well (gal/day/well) was predetermined during an aquifer test

conducted at the site. Initial settings were made in accordance with recommendations described in the pneumatic groundwater pumps instruction booklet determined by the depth the pump was set and the amount of pressure (PSI) applied to the pumps through attachment to the air compressor (Geotech 1.66 Reclaimer Manual, 2003).

Adjustments in the applied pressure and to the cycling time of the wells were made over time to optimize production. For Phase I (MW-5R and MW-12) and Phase II (MW-1 and MW-9A) both wells were connected to the Geotech 1.66 Reclaimer PRS Controller through a multi-attachment dilution valve. Phase III required the use of a separate control box (Geotech Geocontroller II Bladder Pump Logic Unit) for groundwater extraction from well MW-21A. The additional control box became required while targeting Phase III due to the utilization of three wells (MW-10A, MW-21A, and MW-23A) for groundwater extraction rather than two as implemented during Phase I and Phase II.

Slight differences in cycling times were noted between the wells connected to the two control boxes. The Reclaimer contained cycle settings ranging from 10 to 180 seconds while the Geocontroller settings only allowed cycling times up to 30 seconds. Both controllers were manually adjusted

through trial and error episodes until the maximum flow rate was obtained for each well. The operation of groundwater extraction was conducted concurrently with SVE for the majority of the project.

Soil Vapor Extraction (SVE) System

Each phase had SVE remediation applied individually per well for the duration of activity within that phase. Phase I consisted of wells SVE-1, MW-5R, MW-11 and MW-12; Phase II consisted of wells MW-1, MW-2, MW-9A and MW-17A; and Phase III consisted of wells MW-10A, MW-21A and MW-23A. The SVE manifold consisting of varying attached wells was then connected to a "Baker" 200 SCFM Soil Vapor Extraction Unit equipped with a catalytic oxidizing unit.

Vapor induced from the wells were then drawn through an air-water separation tank by the application of a 200-horsepower positive displacement blower. The vapors were then passed into the burner area of the SVE unit where they are instantly incinerated at a temperature of 750 to 800°C. The burner is fueled through a natural gas line connection. Average flow rates, operating temperature, hours of operation, and encountered errors were recorded for weekly maintenance and adjustments.

Operation of the SVE system was performed continuously for each of the wells until the final two to three weeks of operation for a phase of the project, during which time the SVE system was pulsed. Pulsing of the SVE operation was conducted by shutting off the SVE system for approximately three days a week to allow for groundwater extraction within the same well to lower the groundwater level. The soil exposed through the pulsing consisted mainly of the hydrocarbon smear zone and allowed for greater vapor concentrations to be extracted when SVE was restarted for the remaining four days of the week.

SVE Pulsing is routinely implemented at a site when vapor concentrations display low levels of targeted hydrocarbons and also when concentrations reach points of asymptotic results. The use of pulsing theoretically allows vapor concentrations to recover within void space in vadose soils creating both increased recovery rates and vapor concentrations. Application of groundwater extraction in conjunction with SVE pulsing thereby allows for even more exposure of vadose soils for intrusion of hydrocarbon vapors.

Periodic errors with the SVE system included system shutdown following power outages, burner flame failure

during intense storms and periodic maintenance problems. In the event the SVE system was shutdown due to an unexpected error; an additional amount of the time for remediation within that zone was extended accordingly. Errors from either the SVE or the groundwater extraction systems involved with the project accounted for up to four additional weeks of remediation during a phase.

Soil Vapor Extraction Vapor Samples

The SVE system was sampled on a weekly basis utilizing the sampling ports described in the SVE manifold section. A vapor sample from each well was obtained through connection to a sampling box in which negative pressure was created at a higher vacuum than that applied through the manifold. The applied vacuum thereby created flow into the sampling box where a tedlar bag was attached for sample collection. The tedlar bag collected a vapor sample from the attached well until connection was discontinued due to the bag visibly appearing full.

The samples collected from each well were then screened in the field using a photo-ionization detector (PID) meter for detection of volatile organic compounds (VOCs). The readings would be presented in PPM units and

would allow for adjustment of applied vacuum to wells in accordance with the preliminary results.

Exhaust Sample

In accordance with South Coast Air Quality Management District (SCAQMD) standards an exhaust sample was collected from the SVE unit once a month. The exhaust sample consisted of a collection of vapors exiting the SVE unit following incineration. The purpose of the sample was to determine if the vapors exiting the SVE unit were adequately remediated to non-hazardous levels (under 0.24 PPM benzene) after passing through the SVE unit. Furthermore, excessive vapor concentrations entering the SVE unit could result in incomplete combustion of the compounds, creating an airborne hazard for the local population. Elevated exhaust sample concentrations above permitted limits would call for a dilution of the vapors entering the SVE unit or an increase in the operating temperature of the unit from 750°C (catalytic mode) to 1,400°C (thermal mode).

Vapor Samples Analysis

The weekly samples collected from the SVE unit were stored in a sealing container to avoid exposure to sunlight, which may alter the composition of the vapor

sample. Each sample was then recorded for time of collection and analyses to be performed on a Chain-of-Custody document for transfer to Centrum Analytical Laboratories (California Certificate #1555) in Riverside, California. Once there each vapor sample was analyzed for total petroleum hydrocarbons as gasoline (TPH-g) using EPA Method 8015/5030 and BTEX and fuel oxygenates using EPA Method 8260B. The monthly exhaust sample would be run for benzene concentration only (EPA 8260B) due to that being the sole restriction under SCAQMD requirements.

Concentrations of the detected compounds were reported in both micrograms per Liter (ug/L) and parts-per-million (PPM). The detected compounds were then applied to the following formula to determine the approximate amount of hydrocarbons extracted from each well.

ug/L (vapor concentration) * 0.000089712 (unit conversion) * ft^3/min (flow rate) = extracted amount of compound per day * days per week = total amount of compound extracted

*unit conversion of 0.0897 was used for mg/L readings

Samples that indicated non-detectable amounts of a compound were assumed to not contain that compound in concentrations lower than the detection limit. The detected amounts of hydrocarbon concentrations from the weekly vapor samples are presented in Tables 1 and 2 and the estimated amount extracted per weekly, per individual well, is presented in Table 3 all of which are located in Appendix C - Supplemental Tables.

Weekly Measurements and Calculations

During the course of the project, a technician from RME made at least two trips per week to the Sun City SoCo site for sampling, routine maintenance, and performance measurements. Typical measurements for the SVE system would include vacuum and flow levels for each well associated with the active Phase in addition to recording the operating temperature and errors from the system. Pumping rates were obtained from each groundwater extraction line through a timed (usually 1-3 minutes) collection from individual wells to determine the collective amount purged during a 24-hour period. That estimated amount was used to determine performance within the respective wells.

The depth to groundwater measurement most directly reflected the performance of the groundwater extraction system for that week. Measurements were taken during various operational situations to identify effectiveness within the well and possible areas creating limited results. Many of the groundwater measurements were taken while both extraction systems were operational through unscrewing of the airtight well cap and quickly lowering the groundwater meter within the well. The measurement was required to be taken as soon as possible due to decreasing vacuum pressures within the well casing, causing rapid decreases in resulting groundwater elevation and leaving a groundwater measurement that was increasingly becoming non-representative of the well conditions.

Large variations in the groundwater elevations were possible on a week-to-week basis depending on the operation of both the vapor and groundwater extraction systems. With operation of SVE at induced vacuums of approximately 45 inches of water in each well, groundwater elevations were capable of being raised approximately 3 ½ feet prior to initiation of groundwater extraction. Ideally, this induced vacuum would not overwhelm the groundwater extraction

process, which needed to drop overall groundwater elevations to allow for enhanced vapor extraction.

Problems encountered included inadequate groundwater pumping rates and clogging of extraction lines, which commonly led to very slight drops to slight raises in groundwater elevations during the DPE process. Decreases in applied SVE vacuum to the wells were to be avoided to allow for the greatest possible vapor recovery possible while also drawing groundwater towards the well for large groundwater extraction totals. Pulsing of the SVE operations was thereby concluded to be a notion that may provide positive results for the situation. Each phase of the project was thereby operated continuously utilizing both groundwater extraction and SVE for a minimum of five weeks prior to the pulsing of the SVE system. Pulsing consisted of turning the SVE system off for three days out of a week to allow for the drop in the water table through groundwater extraction. At least two weeks of pulsing was allowed during each of the three phases involved with the DPE operation.

A measurement that was also commonly made, although possibly not weekly, was the radius of influence (ROI) of DPE operations in surrounding wells. Collection of the

measurements were done by measuring depth to groundwater in outlying wells from each particular phase to determine if groundwater levels were dropping in response to the groundwater extraction of a nearby well. The groundwater elevation measurements from the wells were compared to measurements conducted during the most recent groundwater sampling event at the site. Measurements taken during groundwater sampling events were made following shutdown of DPE system operation for a minimum of three days to allow for groundwater elevations to stabilize from induced DPE fluctuations. Groundwater elevations were assumed to remain constant during the time between sampling events to help determine the effectiveness in lowering groundwater elevations through extraction. Utilizing these measurements, an approximate ROI could be determined for each zone for use to identify the horizontal distance of potential remediation effects within surrounding well groundwater.

Collection and Disposal of Extracted Groundwater

Groundwater extracted through the submersible pump was transported in tubing ran through the SVE laterals back to the remediation compound. Once there, the tubing for the extracted groundwater was run along the ground, up the side

of a 3,500-gallon "Baker" storage container, and finally released into the opening at the top of the container. This was the location where weekly flow measurements (gallons per minute) were taken from tubes for each well individually. The container was carefully monitored for the amount of purged groundwater present and how much available space was remaining. Flows taken from the extraction well would then be used to calculate how much water was extracted collectively, and the approximate amount of time before the water storage container would become full and overflow. Disposal of the extracted groundwater was conducted through a subcontracted company (Filter Recycling, Inc.) that would empty the container when needed and transport the contaminated water to a site for proper treatment and disposal.

CHAPTER FIVE

RESULTS

DPE of each phase was conducted continuously for a minimum of five weeks with additional time added if errors and maintenance was required. The final two weeks of operation within each phase consisted of a routine of SVE pulsing at a schedule of operation for four days out of a week. The remaining three days the SVE unit was shutdown to allow groundwater extraction to create a cone of depression in the groundwater table around the pumped well. The purpose of the pulsing was to allow for additional exposure of soils within the smear zone resulting in increased hydrocarbon concentrations in the extracted vapors. Results varied in each phase of the project with extracted vapor concentrations increasing with time. Detailed summaries of the work performed and the vapor concentrations collected during each phase of the project are presented below.

Soil Vapor Extraction Results

Presented below is a comprehensive review of the success of SVE through the application of DPE over three phases and for the overall duration of the project.

Phase I - SVE-1, MW-5R, MW-11, and MW-12

DPE of Phase I consisted of groundwater extraction from wells MW-5R and MW-12 with concurrent SVE in both those wells along with groundwater well MW-11 and soil vapor well SVE-1. Remediation within Phase I targeted the former UST area located in the southeast portion of the site where MTBE contamination is of specific concern. The DPE remediation was used to extract groundwater with high MTBE concentrations (≥ 10,000 ug/L) as well as stimulate the biodegradation of the compound through supplying additional oxygen to soils in the subsurface. Work conducted for Phase I of the project was performed between April 23, 2007, and July 9, 2007.

Approximately 6,700 gallons of groundwater was extracted from wells MW-5R and MW-12 during DPE remediation of Phase I. The majority of the water was extracted from well MW-12 due to well MW-5R being pumped "dry" following the first week of groundwater extraction within the zone. The pumping of well MW-5R to a dry status was expected, due

to the well being located in a sparsely continuous to discontinuous water-bearing zone as shown in the Phase I cross-section presented as Figure 3 in Appendix A. Changes in groundwater elevations measured in wells MW-5R and MW-12 varied from increases in elevation due to SVE vacuum effects to approximate 2 feet and 7 feet decreases in wells MW-5R and MW-12, respectively. Using weekly groundwater measurements from both well MW-5R and MW-12, groundwater elevations within the wells were determined and are presented in Appendix B as Graph 1.

SVE results collected from wells included in Phase I indicated only small quantities of hydrocarbon concentrations. The amount of hydrocarbon vapors removed during Phase I through SVE are presented in Table 2 below:

Table 2. Quantities of Recovered Hydrocarbons by Soil Vapor Extraction during Phase I

	TPH-g (lbs)	Benzene (lbs)	Toluene (lbs)	Ethyl-benzene (lbs)	Xylenes (lbs)	MTBE (lbs)
SVE-1	0.00	0.00	0.00	0.00	0.00	0.04
MW-5R	0.00	0.03	0.02	0.00	0.00	0.11
MW-11	0.00	0.00	0.00	0.00	0.00	0.00
MW-12	3.63	0.00	0.00	0.00	0.00	0.00
Phase I Totals	3.63	0.03	0.02	0.00	0.04	0.15

Source: "Results of Groundwater Extraction and Soil Vapor Extraction (SVE), Sun City SoCo (Walgreens Store), 26771 McCall Blvd., Sun City, California," prepared by R M Environmental, Inc., dated March 10, 2008.

Phase II - MW-1, MW-2, MW-9A, and MW-17A

DPE of Phase II consisted of groundwater extraction from wells MW-1 and MW-9A with concurrent SVE in both those wells along with groundwater wells MW-2 and MW-17A. Remediation within Phase II was targeting the former eastern fuel dispensing area located on the eastern border of the site where TPH-g and BTEX contamination is of specific concern. Remediation of MTBE contamination is also targeted, although to a lesser extent then Phase I, through

groundwater extraction of MTBE contaminated waters (≥ 1,000 ug/L) and biodegradation of subsurface soils. Work conducted for Phase II of the project was performed between July 17, 2007, and October 4, 2007.

The amount of extracted groundwater from Phase II of the project was approximately 12,800 gallons, double the amount extracted from Phase I. The additional pumped groundwater can be attributed to equal production from both pumped wells in contrast to well MW-5R being pumped dry during Phase I. Changes in groundwater elevations measured in pumped wells MW-1 and MW-9A varied from increases in elevation due to SVE vacuum effects to approximate 3 1/2 foot and 4 foot decreases in the wells, respectively. Groundwater elevations determined through weekly groundwater measurements from wells MW-1 and MW-9A for the duration of Phase II are presented on in Appendix B – Graphs, as Graph 2. Remediation within Phase II was extended several weeks due to operational problems with the groundwater extraction pumps and routine maintenance that was required.

SVE results from Phase II were vastly improved over those from Phase I in terms of the amount of hydrocarbons recovered from the wells. Approximately 40 pounds of

hydrocarbons were collectively recovered in the samples from wells MW-1, MW-2, MW-9A, and MW-17A, although little to no amounts of hydrocarbons were detected in the vapor samples collected from wells MW-2 and MW-17A. The amount of hydrocarbon vapors removed during Phase II through SVE are presented in Table 3 below:

Table 3. Quantities of Recovered Hydrocarbons by Soil Vapor Extraction during Phase II

	TPH-g (lbs)	Benzene (lbs)	Toluene (lbs)	Ethyl-benzene (lbs)	Xylenes (lbs)	MTBE (lbs)
MW-1	30.35	0.00	0.48	0.16	1.61	0.00
MW-2	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A	6.86	0.00	0.13	0.07	0.58	0.00
MW-17A	0.00	0.00	0.03	0.00	0.04	0.00
Phase II Totals	37.21	0.00	0.63	0.23	2.27	0.00

Source: "Results of Groundwater Extraction and Soil Vapor Extraction (SVE), Sun City SoCo (Walgreens Store), 26771 McCall Blvd., Sun City, California," prepared by R M Environmental, Inc., dated March 10, 2008.

Phase III - MW-10A, MW-21A, and MW-23A

DPE of Phase III consisted of both groundwater extraction and SVE from wells MW-10A, MW-21A, and MW-23A. Remediation within Phase III was targeting the western portion of the site where TPH-g and BTEX contamination is of specific concern. MTBE contamination was not targeted due to the compound never being detected in groundwater samples collected from the utilized wells. Work conducted for Phase III of the project was performed between October 11, 2007, and December 3, 2007.

The amount of extracted groundwater from Phase III of the project was approximately 21,900 gallons, slightly over 70% more than the amount extracted from Phase II and over 300% the water extracted from Phase I. The additional amount of extracted groundwater can be attributed to groundwater being extracted from three wells continuously rather than two as is the previous phases. Changes in groundwater elevations measured in pumped wells MW-10A, MW-21A, and MW-23A varied from increases in elevation due to SVE vacuum effects to approximate 1 foot, 3 ½ feet, and 1 foot decreases in the wells, respectively. Utilizing weekly groundwater measurements from the wells, groundwater

elevations within the wells were determined and are presented in Appendix B as Graph 3.

Remediation within Phase III was extended several weeks due to operational problems with the groundwater extraction pumps and increased production within attached wells.

SVE results from Phase III showed dramatic improvement over both Phase I and Phase II due to the increased amount of hydrocarbons recovered from the wells and the additional amount of extracted groundwater. Approximately 443 pounds of hydrocarbons were collectively recovered in the samples collected from wells MW-1, MW-2, MW-9A, and MW-17A, although little to no amounts of hydrocarbons were detected in the vapor samples collected from wells MW-2 and MW-17A. The amount of hydrocarbon vapors removed during Phase III through SVE are presented in Table 4 below:

Table 4. Quantities of Recovered Hydrocarbons by Soil Vapor Extraction during Phase III

	TPH-g (lbs)	Benzene (lbs)	Toluene (lbs)	Ethyl-benzene (lbs)	Xylenes (lbs)	MTBE (lbs)
MW-10A	114.89	0.32	1.88	0.28	2.60	0.00
MW-21A	75.47	0.12	1.11	0.21	1.13	0.00
MW-23A	238.30	0.38	2.42	0.34	3.12	0.00
Phase III Totals	428.66	0.82	5.41	0.83	6.85	0.00

Source: "Results of Groundwater Extraction and Soil Vapor Extraction (SVE), Sun City SoCo (Walgreens Store), 26771 McCall Blvd., Sun City, California," prepared by R M Environmental, Inc., dated March 10, 2008.

Overall Soil Vapor Extraction Results

Based on the results from each of the three respective phases included in the project, it can be seen that the work associated with Phase III resulted in the extraction of the most hydrocarbon compounds in comparison to the two previous phases. A breakdown of the amount of vapors collectively extracted during each phase of the project is presented in Table 5 below:

Table 5. Quantities of Hydrocarbons Recovered per Phase by Soil Vapor Extraction

	TPH-g (lbs)	Benzene (lbs)	Toluene (lbs)	Ethyl-benzene (lbs)	Xylenes (lbs)	MTBE (lbs)
Phase I	3.63	0.03	0.02	0.00	0.04	0.15
Phase II	37.21	0.00	0.63	0.23	2.27	0.00
Phase III	428.66	0.82	5.41	0.83	6.85	0.00
Total Amount Recovered	469.50	0.85	6.24	1.06	9.16	0.15

Source: "Results of Groundwater Extraction and Soil Vapor Extraction (SVE), Sun City SoCo (Walgreens Store), 26771 McCall Blvd., Sun City, California," prepared by R M Environmental, Inc., dated March 10, 2008.

Results from the vapor samples collected weekly for each phase are summarized in Tables 1 and 2 of Appendix C - Supplemental Tables, of this report. Calculated vapor quantities removed through SVE utilizing weekly sample concentrations and flow rates for individual wells are presented as Table 3 in Appendix C.

Phase III Analysis

An in depth look at hydrocarbon concentrations present in the weekly vapor samples collected from the wells utilized for Phase III (MW-10A, MW-21A, MW-23A) provide an

indication of the conditions at which the most productive vapor results are obtained. Located in Appendix B, Graphs 4A through 4C present the TPH-g concentration and Graphs 5A through 5C present the benzene concentration in the vapor samples in comparison with the measured groundwater elevation from wells MW-10A, MW-21A, and MW-23A, respectively. Both compounds were noted to maintain concentration trends very similar to one another although on differing scales. TPH-g concentrations ranged from single digits to hundreds of parts-per-million (PPM) while the benzene concentrations ranged from zero to a maximum of approximately 3.5 PPM.

Vapor samples results showed that TPH-g appeared to be present within the wells at a fairly steady pattern of increasing concentrations, although peaks and valleys in concentration are present. The increasing efficiency of DPE due to corrections in groundwater pumping and SVE flow rates made weekly seem to be the cause for the increase in results. Benzene concentrations within the samples displayed a more erratic pattern and were present in much lower concentrations. Large rebounds in the concentration of both TPH-g and benzene was seen when SVE pulsing was implemented within the wells. The rebound is attributed to

the pulsing operation allowing void spaces within the wells to re-accumulate volatile hydrocarbon compounds following a minimum of five weeks of continuous SVE operation. Additionally, single operation of groundwater extraction created decreased groundwater elevations; further exposing previously submerged capillary fringe and smear zone soils.

Analyzing the results of the vapor samples collected from groundwater wells MW-10A and MW-23A an interesting pattern seems apparent, hydrocarbon concentrations within well MW-10A appear to decrease with time while concentrations within well MW-23A appear to increase with time. Graphs 4A and 4C present the TPH-g concentrations and graphs 5A and 5C present the benzene concentrations of wells MW-10A and 23A, respectively. The graphs are located in Appendix B - Graphs. The reason for the dramatic difference in concentration trends can be a result of several potential factors.

The geology encountered in the soils within the two wells is implicitly different. Well MW-10A is screened in a sandy silt lense in comparison to well MW-23A, which is mainly screened in a sand layer. As a result, contamination present in the capillary fringe and smear zone soils within well MW-10A may be unable to mobilize due to the intrinsic

permeability and connectivity of the silty soil being lower than the sand encountered in well MW-23A. Rationale proves this to be a likely possibility for the difference in concentration trends due to measured groundwater levels in wells MW-10A and MW-23A showing almost identical elevations during the extent of DPE for Phase III, seemingly identifying that it was the variation in geologic conditions rather than differences in groundwater extraction performance that limited SVE remediation from well MW-10A. An alternative reason for lackluster vapor results from well MW-10A is that well MW-23A could be extracting the volatile vapors from MW-10A due to a predetermined radius of influence for SVE remediation in excess of 50 lateral feet, which was confirmed in measurements made at the site during DPE.

Comparison of Prior Soil Vapor Extraction and Dual Phase Extraction Vapor Results

Between December 2003 and December 2004, SVE remediation was conducted at the site in numerous well including MW-10A, MW-21A, and MW-23A. Graphs indicating detected TPH-g from monthly vapor samples collected during previous SVE remediation from wells MW-10A, MW-21A, and

MW-23A are presented in Appendix B as Graphs 6A through 6C and detected benzene concentrations are presented in Graphs 7A through 7C, respectively. By comparing the TPH-g and benzene concentrations between the previous SVE period and the vapor samples collected during the DPE at the site it can be determined if the addition of groundwater extraction during DPE remediation resulted in increased removal of these volatile compounds through exposure of former submerged contamination. Although the data is presented over different timelines, a comparison of the status of the wells following two months of remediation can provide insight on the progress during the two separate remediation events.

Overall, TPH-g concentrations in wells MW-10A, MW-21A, and MW-23A all showed increased concentrations during the vapor samples collected during the DPE remediation in comparison to the previous SVE remediation, following two months of constant operation. TPH-g concentrations increased approximately 400%, 14%, and 295% (in terms of PPM) in wells MW-10A, MW-21A, and MW-23A, respectively, during DPE operations in comparison to previous SVE remediation samples. The increased concentrations are

attributed to the exposure of capillary fringe and smear zone soils previously unable to be extracted.

A comparison of the benzene results over a two months period does not provide much information due to the concentrations revealing results varying from slight increases to slight decreases between the DPE and previous SVE vapor results. The variation in benzene results occur in a limited capacity in that the detected range of the compound was very small (from non-detectable at 0.41 ug/L to a maximum of 1.0 ug/L) thereby prohibiting an in depth analysis of the compound.

Groundwater Elevation Trends

Large variations in the elevation of groundwater within a well were noted throughout the project. The changes in groundwater elevation can be attributed to changing site conditions and the numerous applied methods of DPE during the extent of the project. Normal operation of both groundwater extraction and SVE resulted in a wide range of changes in groundwater elevation from elevating the groundwater due to the excessive application of SVE or inadequate amounts of groundwater extraction, to large decreases in groundwater elevation when both DPE systems

are working properly. Operational efficiency and corresponding improved results were gradually achieved after several weeks of operation within each phase of the project as the decreases in groundwater elevation became larger throughout the process.

Pulsing of the SVE system following the initial five to six weeks of continuous DPE operation accounted for the period of the largest measured decreases in groundwater elevation. The large decreased groundwater elevation was anticipated to take place due to the lack of SVE operations, which previously raised groundwater elevation, and the continuous operation of groundwater extraction.

Similar trends in groundwater elevations were noted in the group of wells utilized for DPE during each phase of the project. For instance, if well MW-1 showed a decrease in groundwater elevation during the implementation of Phase II, so did well MW-9A, which was also being used for DPE at that time. The one exception was in the performance of wells MW-5R and MW-12 for DPE during Phase I in which well MW-5R was pumped dry following one week of DPE. Therefore, well MW-5R did not demonstrate increases or decreases in groundwater elevation corresponding with that of well MW-12.

Groundwater Quality Analysis

The improvement of groundwater quality at the site through the application of DPE was the main objective of the project. Between Phase I through Phase III approximately 41,400 gallons of water were extracted through the use of the pneumatic submersible pump in wells MW-1, MW-5R, MW-9A, MW-10A, MW-12, MW-21A, and MW-23A. Although significant amounts of hydrocarbon vapors were not extracted from each of the targeted phases in the application of SVE, enhanced biodegradation of hydrocarbon compounds appeared to occur within the radius of influence of the wells utilized for each respective phase. A comparison of groundwater quality data collected prior to the implementation of the DPE project, in conjunction with DPE, and following completion of DPE at the site is presented for TPH-g, benzene, and MTBE in Tables 6 through 8, as follows.

Table 6. Comparison of TPH-g Concentrations (mg/L) in Groundwater Samples

Sampling Date	PHASE 1			PHASE 2				PHASE 3		
	MW-5R	MW-11	MW-12	MW-1	MW-2	MW-9A	MW-17A	MW-10A	MW-21A	MW-23A
4/4/2007	14	7.0	0.16	66	18	69	0.61	81	81	69
7/17/2007	Well Dry	7.7	7.8	100	22	74	0.33	NS*	NS*	NS*
10/9/2007	<0.10	12	6.7	87	6.3	65	0.11	120	51	91
1/10/2008	Well Dry	3.5	1.7	77	2.5	45	0.54	96	91	89
4/22/2008	4.2	10	0.92	73	11	42	0.34	97	71	86

Source: Adapted from RME, March 2008

Table 7. Comparison of Benzene Concentrations (ug/L) in Groundwater Samples

Sampling Date	PHASE 1			PHASE 2				PHASE 3		
	MW-5R	MW-11	MW-12	MW-1	MW-2	MW-9A	MW-17A	MW-10A	MW-21A	MW-23A
4/4/2007	<50	2,700	<0.5	780	72	580	<2.5	4,400	7,200	5,600
7/17/2007	Well Dry	2,500	340	980	88	530	<1.0	NS*	NS*	NS*
10/9/2007	<0.5	4,000	1,200	410	24	230	<0.5	4,800	2,700	6,400
1/10/2008	Well Dry	1,100	230	170	10	200	5.5	3,500	2,900	4,400
4/22/2008	<5.0	2,800	97	110	22	160	<0.5	3,900	1,900	3,800

Source: Adapted from RME, March 2008

Table 8. Comparison of MTBE Concentrations (ug/L) in Groundwater Samples

Sampling Date	PHASE 1			PHASE 2				PHASE 3		
	MW-5R	MW-11	MW-12	MW-1	MW-2	MW-9A	MW-17A	MW-10A	MW-21A	MW-23A
4/4/2007	23,000	<50	250	1,600	340	2,300	700	<250	<100	<100
7/17/2007	Well Dry	<50	5,700	3,800	350	2,700	220	NS*	NS*	NS*
10/9/2007	<1.0	<50	660	3,500	110	430	8.4	<100	<100	<100
1/10/2008	Well Dry	<10	130	460	56	340	26	<100	120	<100
4/22/2008	3,900	<10	29	240	270	240	24	<100	<100	<100

Source: Adapted from RME, March 2008

Groundwater analytical results shown from the July 17, 2007, and October 9, 2007, groundwater sampling events were conducted partially through performance of DPE at the site although the DPE system was shutdown in advance of the sampling event to allow for groundwater conditions to become static prior to depth to groundwater measurements and collection of groundwater samples. The April 4, 2007, groundwater analytical data was included to present groundwater data for the site prior to implementation of DPE at the site. January 10, 2008, and April 22, 2008, sampling data present water quality information for DPE wells following approximately one and four months of non-operation, respectively.

CHAPTER SIX

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The SoCo site is unique, with previous site use as a gasoline station for twenty years that has resulted in contaminated soil and groundwater beneath the site in. The geologic setting has created a discontinuous upper, or perched, aquifer above a continuous lower aquifer. Contamination at the site has been mostly defined through exploratory borings in which soil samples were collected as well as the installation of twenty-six groundwater monitoring wells used to define the lateral and horizontal extent of both soil and groundwater contamination. Previous remediation conducted at the site includes the removal of approximately 217 gallons of hydrocarbon free-product from groundwater wells MW-1 through MW-4, MW-8, MW-9A, and MW-10A between November 1999 and April 2004; and SVE remediation from December 2003 through December 2004 resulting in the extraction of approximately 3,684 pounds of TPH-g and 719 pounds of BTEX and fuel oxygenates.

Quarterly groundwater monitoring events at the site has shown large amounts of TPH-g, BTEX, and fuel oxygenate

compounds persist in the upper aquifer underlying the site. It was determined that the remaining contamination at the site must lie in the groundwater capillary zone and smear zones which were previously unavailable for remediation due to being submerged below the groundwater table within the upper aquifer. These areas were decided to be the most likely source of the continued groundwater contamination due to the site being redeveloped into a Walgreens drugstore and all the materials and structures previously associated with the gas station being removed from the site.

The process of dual phase extraction (DPE) was considered to be the best possibility available to alleviate the remaining source contamination present beneath the site. The rationale behind the use of DPE was that groundwater extraction within a well would create a cone of depression in the groundwater table within the proximity of the well, allowing for extraction of previously submerged contamination through the application of soil vapor extraction (SVE). Three areas of particularly high amounts of dissolved hydrocarbons in the collected groundwater samples were identified and sectioned into Phases I, II, and III, respectively. Application of DPE was

separately applied to each of these phases for a minimum of six weeks. During that time consecutive operation of SVE was maintained for a minimum of five weeks followed by two weeks of pulsed operation (on four days, off three days).

Weekly depth to groundwater measurements and flow rates were collected to determine the operational efficiency of the groundwater extraction portion of the DPE system. At the same time, measurements were collected from the SVE system also which included the vacuum and flow rates created in each well followed by vapor sampling from each well for analysis for TPH-g and BTEX and fuel oxygenates. Concentrations of detected compounds for each well was then combined with the flow rate (CFM) and multiplied to determine the approximate amount of the compound extracted between vapor sample collections. Computed amounts of extracted compounds were made per well per phase as a method of determining the productivity of DPE in the attached wells.

Computed amounts of hydrocarbons extracted were combined for each phase for comparison and analysis. Collectively, approximately 4 pounds, 40 pounds, and 443 pounds of hydrocarbon compounds were removed from Phase I, Phase II, and Phase III, respectively. Enhanced

biodegradation of hydrocarbon compounds dissolved in groundwater was an additional indicator of performance within the separate phases conducted at the site. Comparison of samples collected prior to the implementation of DPE to samples collected following completion of DPE at the site (approximately one year) were utilized to determine the effectiveness of DPE in the remediation of dissolved hydrocarbons in groundwater. Overall, the amount of dissolved TPH-g, benzene, and MTBE in wells included in the DPE of the site have shown trends of slight increases in a small amount of wells to decreases of up to 79% of TPH-g, 91% of benzene, and 99% of MTBE. The general results on the effectiveness of DPE throughout the site is that TPH-g was lowered by 39%, benzene was lowered by 58%, and MTBE was lowered by 93% on average in the wells that experienced a decrease in the compounds.

Conclusions

Based on the results obtained from both vapor and groundwater samples, DPE can be deemed as an effective remediation process for hydrocarbon contamination in capillary fringe and smear zone areas at the site. Removal of capillary fringe and smear zone contamination is a

problematic process in that the targeted contamination is commonly submerged, resulting in low recovery through typical SVE. In these circumstances it is required to either lower the groundwater table to allow the SVE process to remove or biodegrade the contamination; or to utilize costly excavation of the deep contamination for remediation purposes.

Although substantial amounts of hydrocarbon vapors were not removed during Phase I and Phase II of the project, it can be argued that the biodegradation created through the influx of oxygen to the subsurface by SVE caused an enhancement of remediation greater than that of standard SVE hydrocarbon vapor removal. Furthermore, it appears apparent that the only wells extracting adequate amounts of hydrocarbon vapors are those that are concurrently extracting groundwater. Therefore, it can be concluded that for proper cost effectiveness in future DPE remediation of the site SVE be limited only to wells that are in the process of extracting groundwater concurrently.

The apparent biodegradation of hydrocarbon compounds in wells lacking production of extractable SVE hydrocarbon vapors indicate that further cycling of oxygen within the subsurface of hydrocarbon impacted wells can be beneficial.

It can be concluded that the addition of oxygen to the subsurface without the process of SVE, as with bioventing, will result in additional biodegradation of hydrocarbon compounds within the wells. Bioventing, or the venting of the atmosphere to the subsurface, is a method of hydrocarbon remediation that is very cost effective and efficient and seems to be a very practicable remediation method for the SoCo site.

The application of DPE at the site has yielded numerous important conclusions for use with additional remediation in the future. As described above; only wells utilized for groundwater extraction should be targeted for SVE to improve the cost effectiveness of SVE remediation at the site. Furthermore, carbon-activated technology (CAT) vapor remediation would be a less expensive alternative to the SVE remediation that was applied as part of this project. CAT remediation is available for consideration at the site due to the lower concentrations of hydrocarbons detected in vapor samples collected from the attached wells. Bioventing may also be used in wells that displayed non-detectable amounts of targeted hydrocarbon compounds for the duration of their respective phases; in order to

promote further biodegradation of dissolved hydrocarbons within the wells.

Recommendations

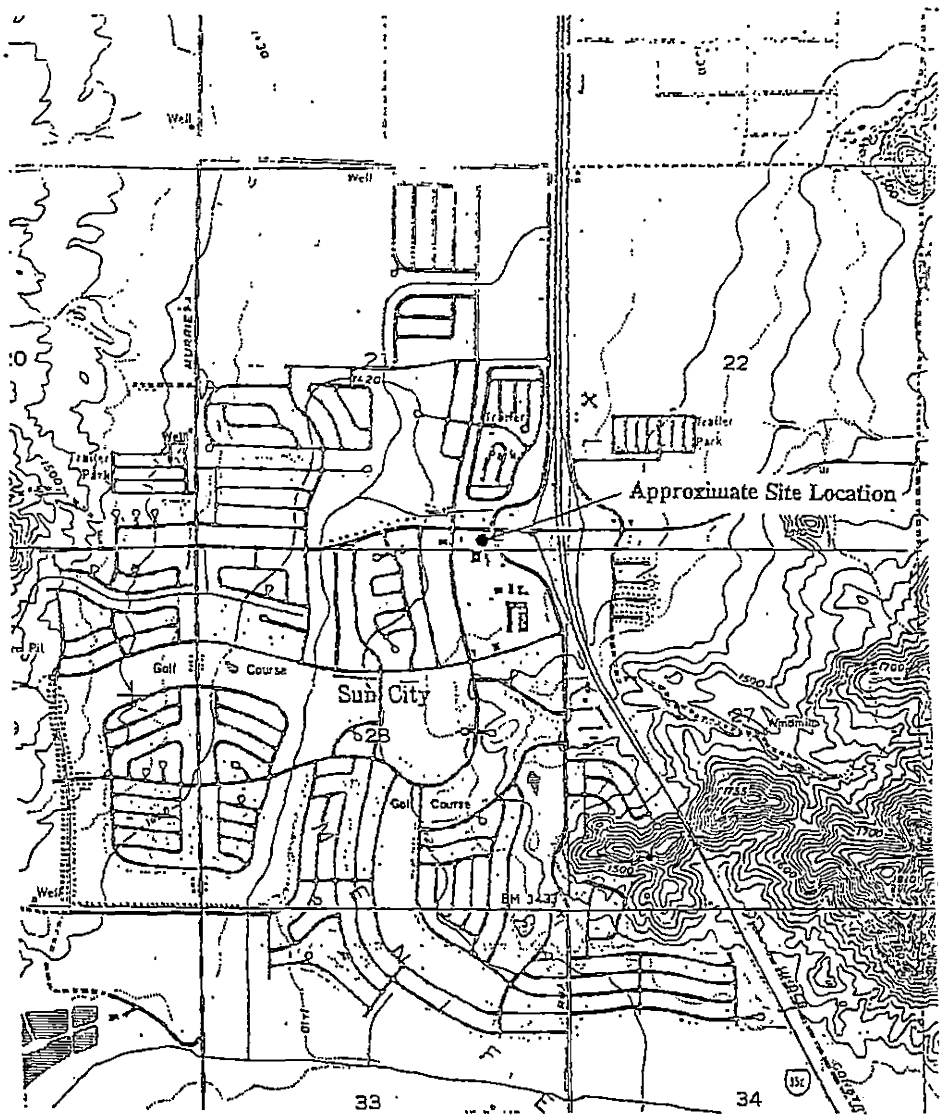
In taking on a project such as this in which a student incorporates their Thesis work into work done in coordination with their employers; the utmost discretion must be used in how the project in described, executed, and reported. All work must acknowledge contributions by previous employees that will be utilized as well as work done by current employees as part of the project process. It should be noted that if work completed by a student for an employer is to be used as part of that students Thesis project, the employer and the client that the work is being done for must give permission for the release of the information; if there is a client.

Special care is required for projects such as these in which a specific definition is lacking in terms of the process of referencing the information used. By that I mean work can be done by the student at their workplace for use by their employer but also used by the student for their Thesis. It is a case such as this in which the vagueness of

the creativity used for a project can come into question as to who holds the rights for the written material.

APPENDIX A

FIGURES



Scale 1" = 2,000'

Reference: U.S.G.S. Map, Dated 1953, Photo-revised 1979, Romoland Quadrangle, 7.5 Minute Series

Site Location Map	Sun City SoCo 26771 McCall Blvd., Sun City, CA	FIGURE 1

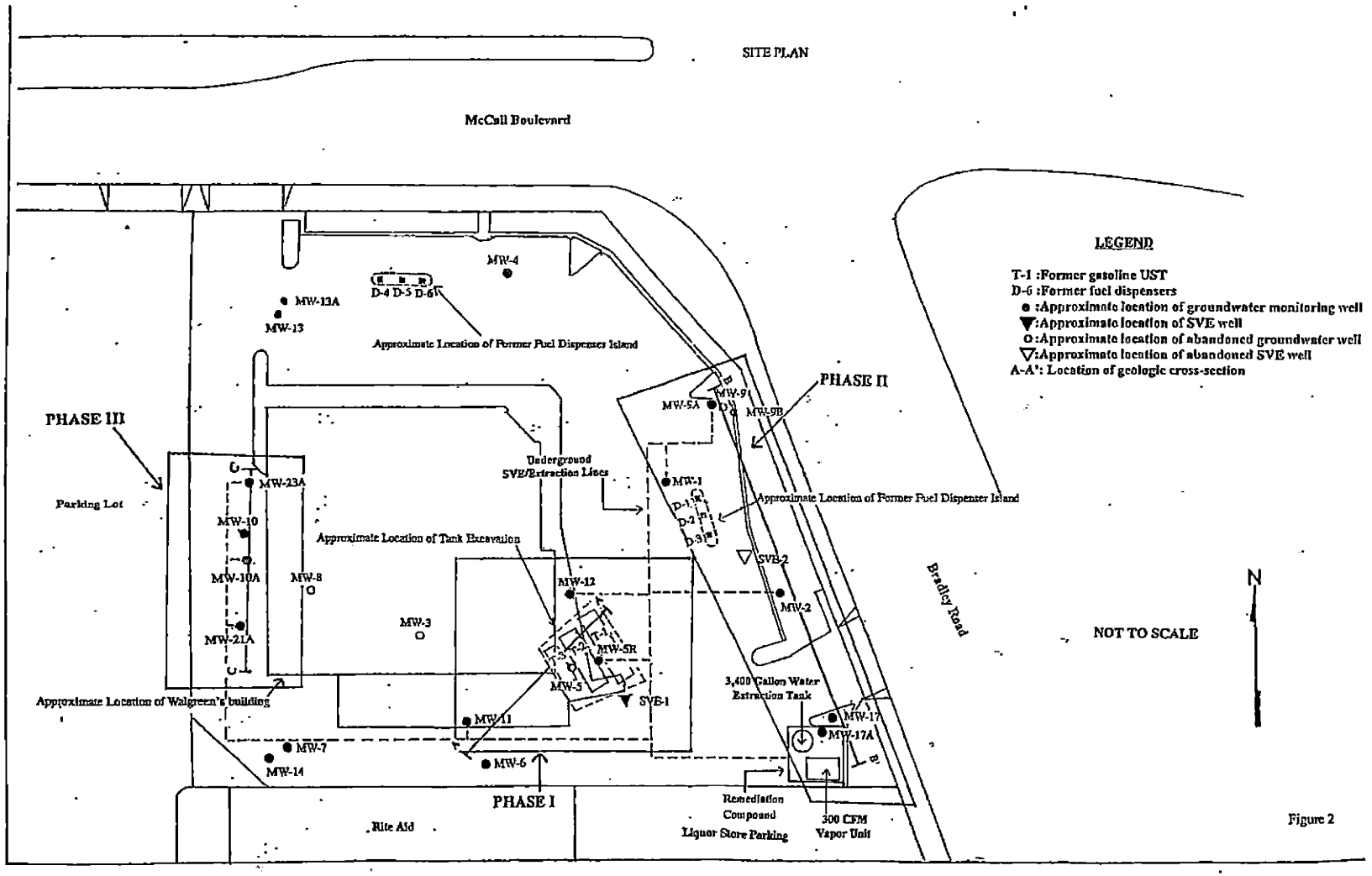
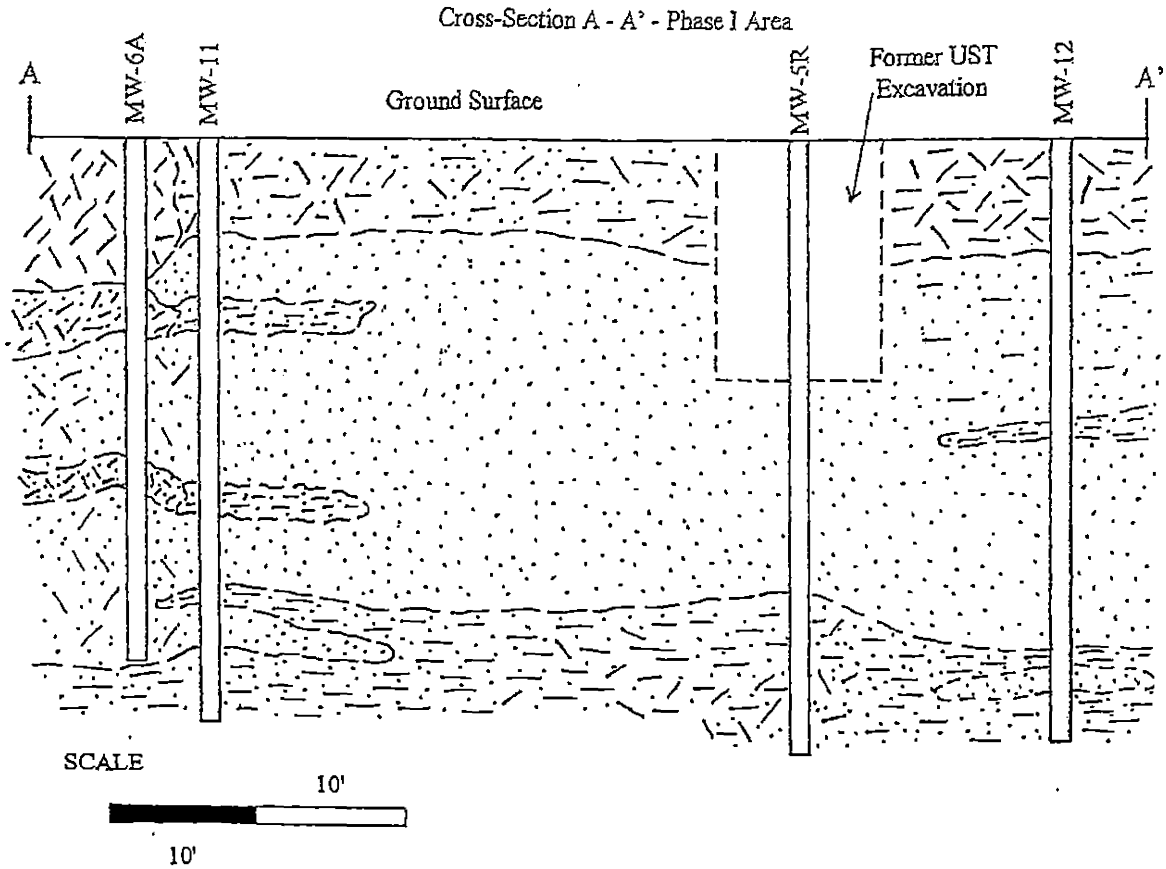

SITE PLAN
McCall Boulevard
LEGEND
T-1 :Former gasoline UST
D-6 :Former fuel dispensers
●:Approximate location of groundwater monitoring well
▼:Approximate location of SVE well
○:Approximate location of abandoned groundwater well
▽:Approximate location of abandoned SVE well
A-A': Location of geologic cross-section
PHASE III
PHASE II
PHASE I
Parking Lot
Underground SVE/Extraction Lines
Approximate Location of Former Fuel Dispenser Island
Approximate Location of Tank Excavation
Approximate Location of Walgreen's building
Bradley Road
NOT TO SCALE
N
3,400 Gallon Water Extraction Tank
Remediation Compound
300 CFM Vapor Unit
Liquor Store Parking
Rite Aid
MW-4
MW-13A
MW-13
D-4 D-5 D-6
MW-9
MW-9A
MW-9B
MW-1
D-1
D-2
D-3
SVE-2
MW-2
MW-23A
MW-10
MW-10A
MW-8
MW-3
MW-21A
MW-12
MW-5R
MW-5
SVE-1
MW-11
MW-7
MW-14
MW-6
MW-17
MW-17A
A
A'
B
B'

Figure 2



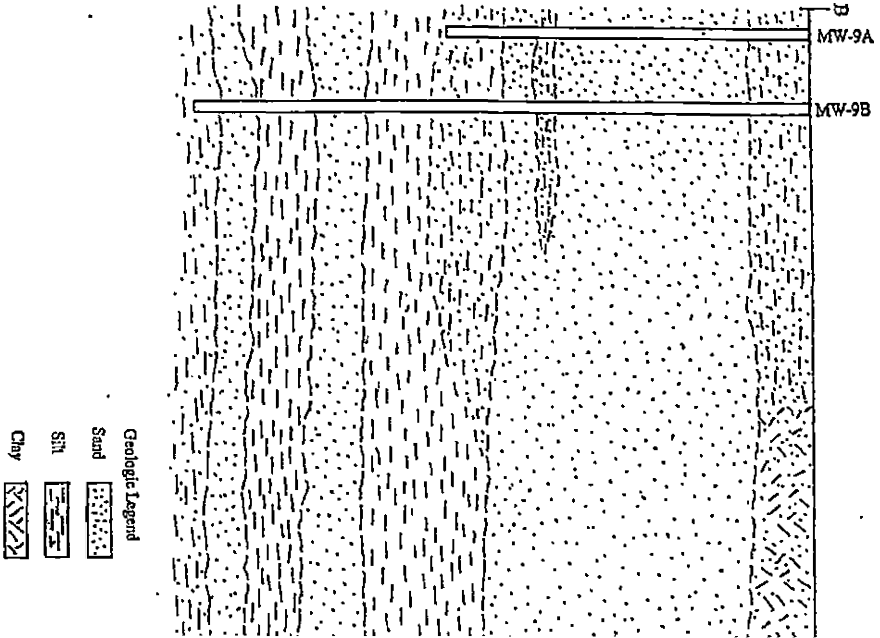
Geologic Legend

Sand

Silt

Clay

Figure 3


B
MW-9A
MW-9B
Geologic Legend
Sand
Silt
Clay

Cross-Section B - B' - Phase II Area

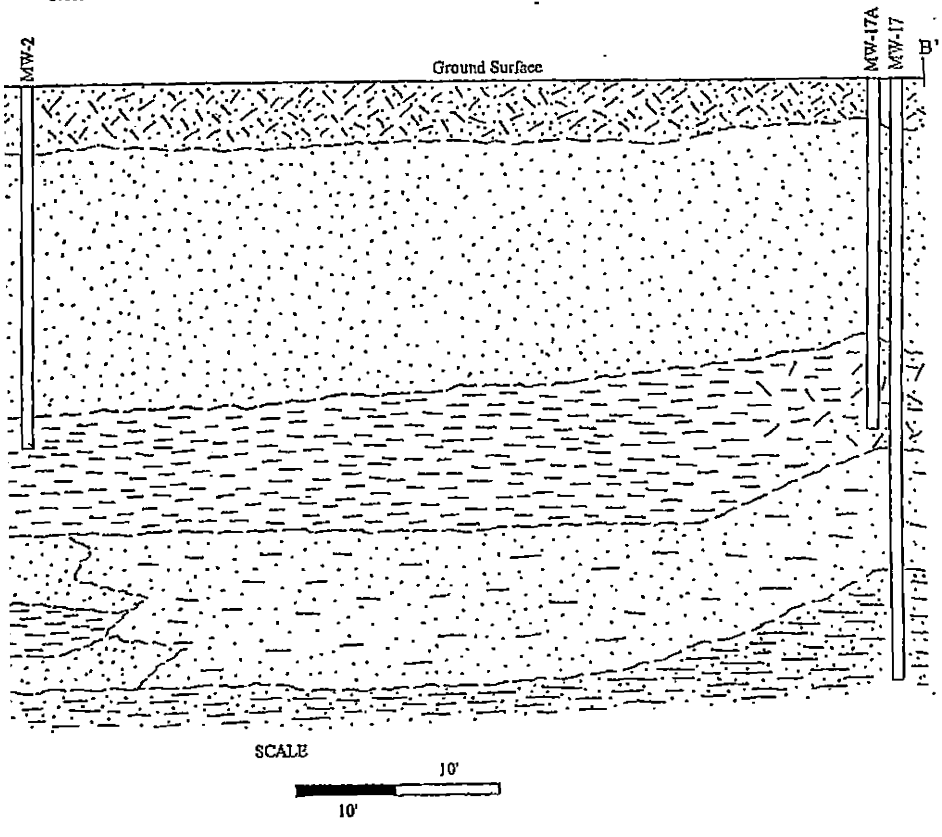


Figure 4

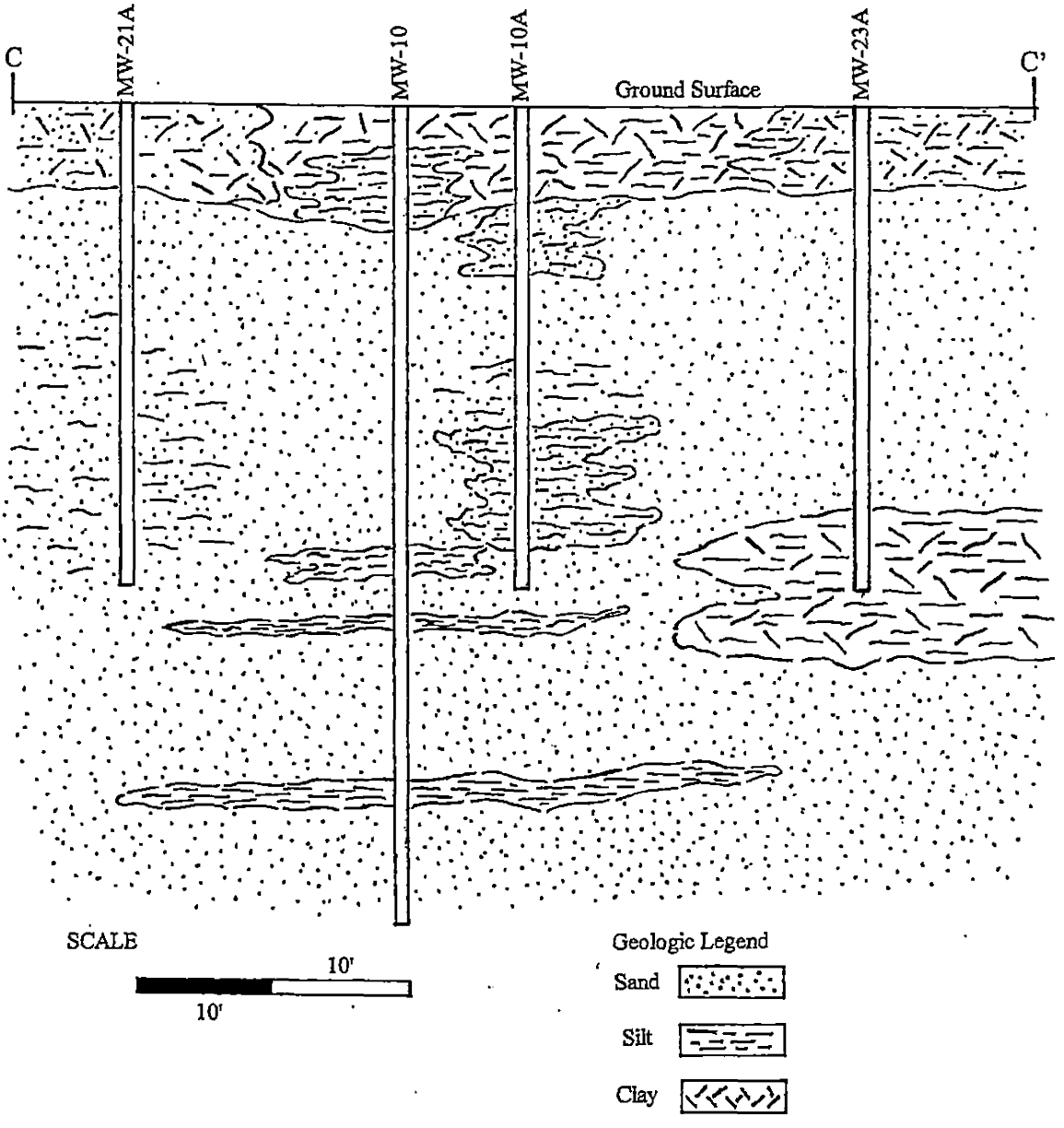
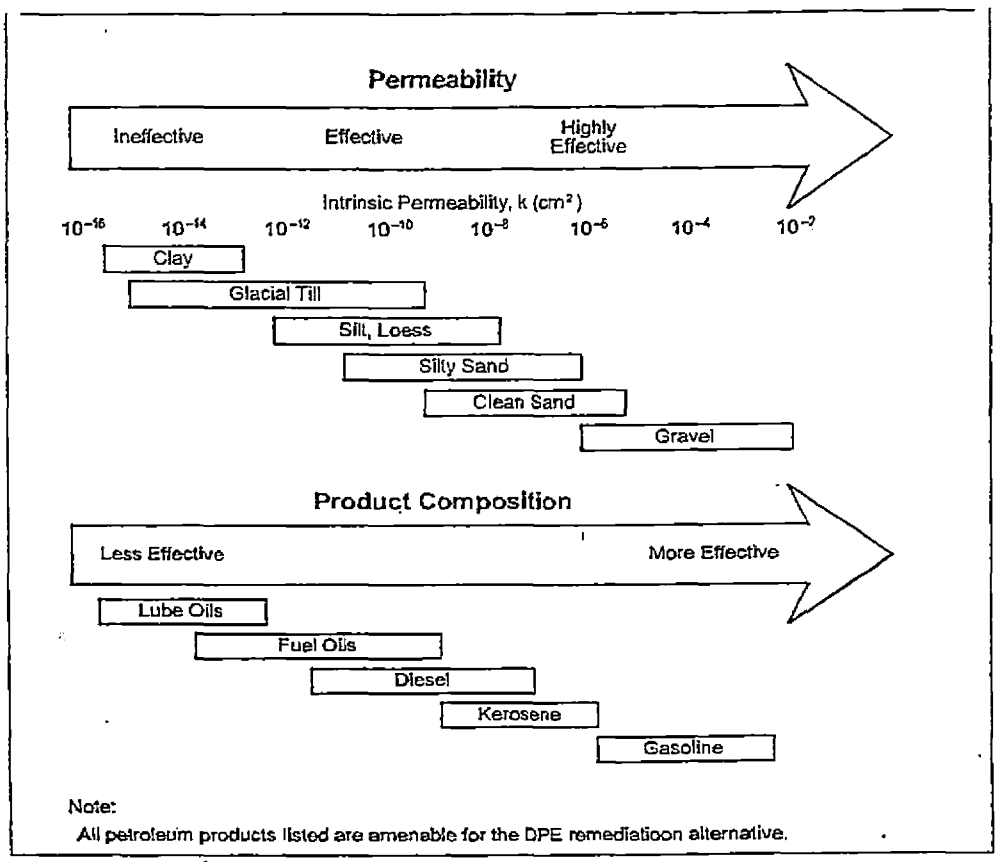

C
MW-21A
MW-10
MW-10A
Ground Surface
MW-23A
C'
SCALE
10'
10'
Geologic Legend
Sand
Silt
Clay

Figure 5

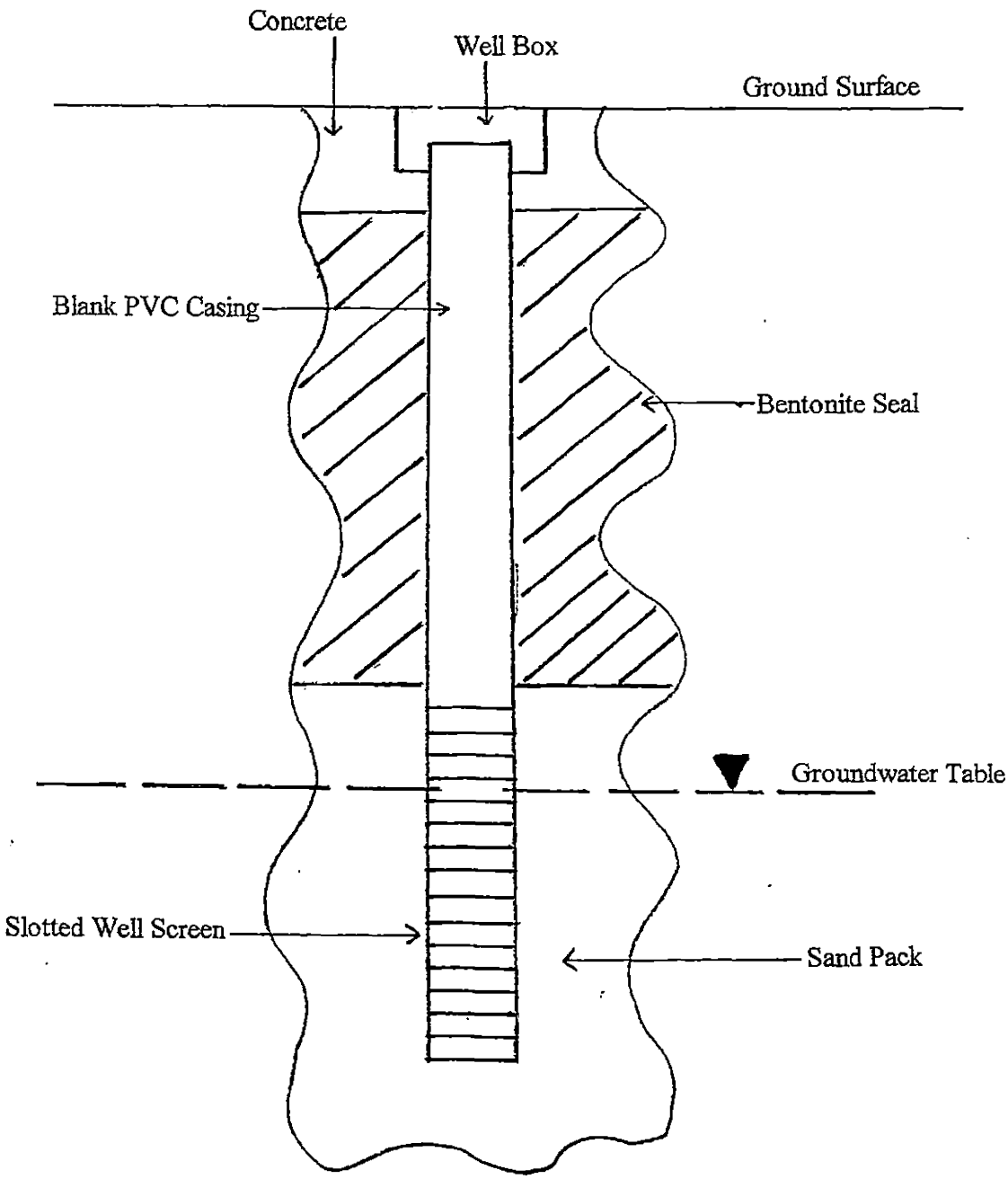
Effectiveness of DPE Based on Product Composition and Soil Permeability



Source: "How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan reviewers: Chapter XI: Dual-Phase Extraction," EPA, May 1995, Exhibit XI-8

Figure 6

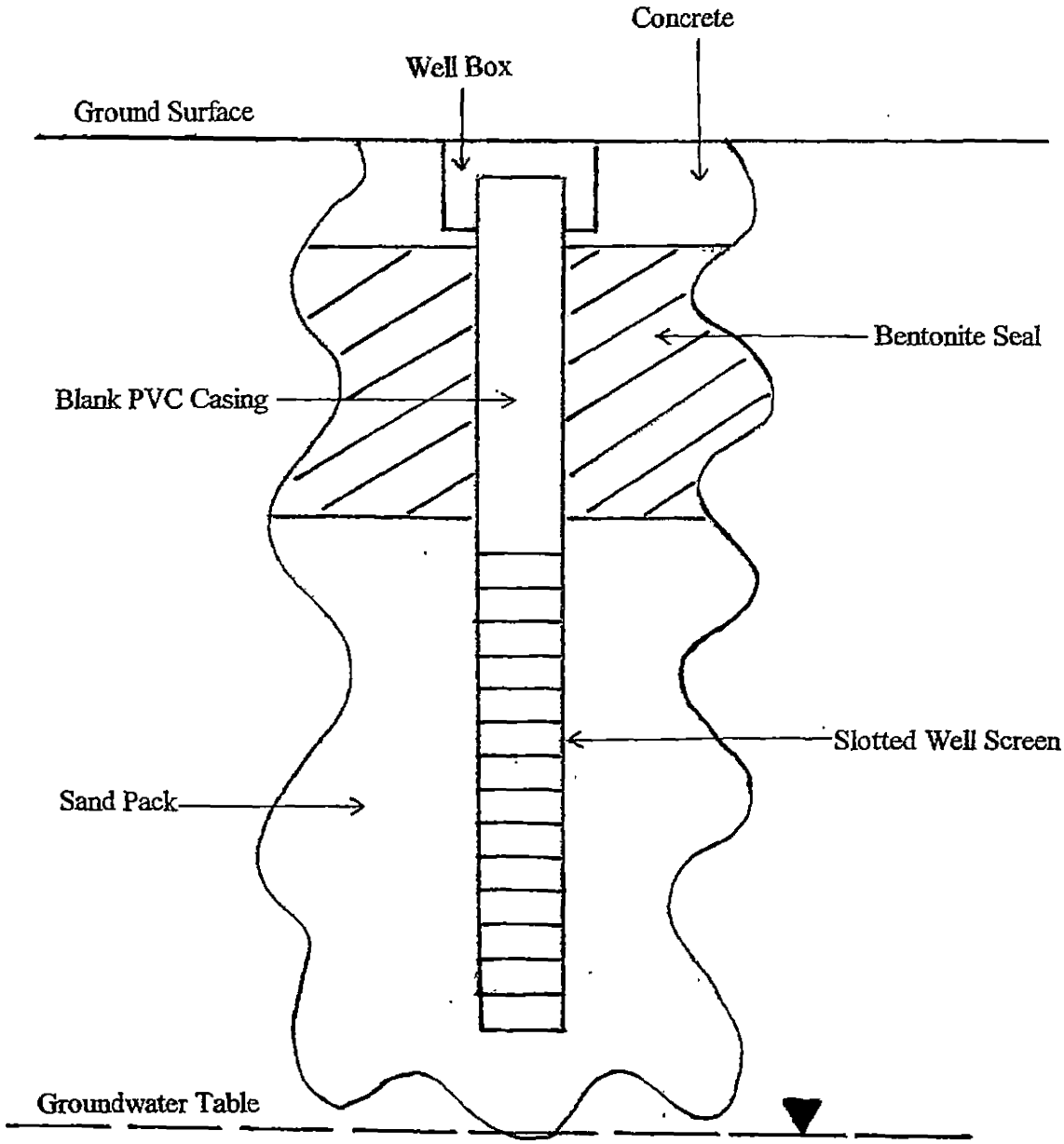
Standard Groundwater Monitoring Well Construction Diagram



Not To Scale

Figure 7

Standard Soil Vapor Extraction (SVE) Well Construction Diagram



Not To Scale

Figure 8

Dual Phase Extraction (DPE) Well Construction Diagram

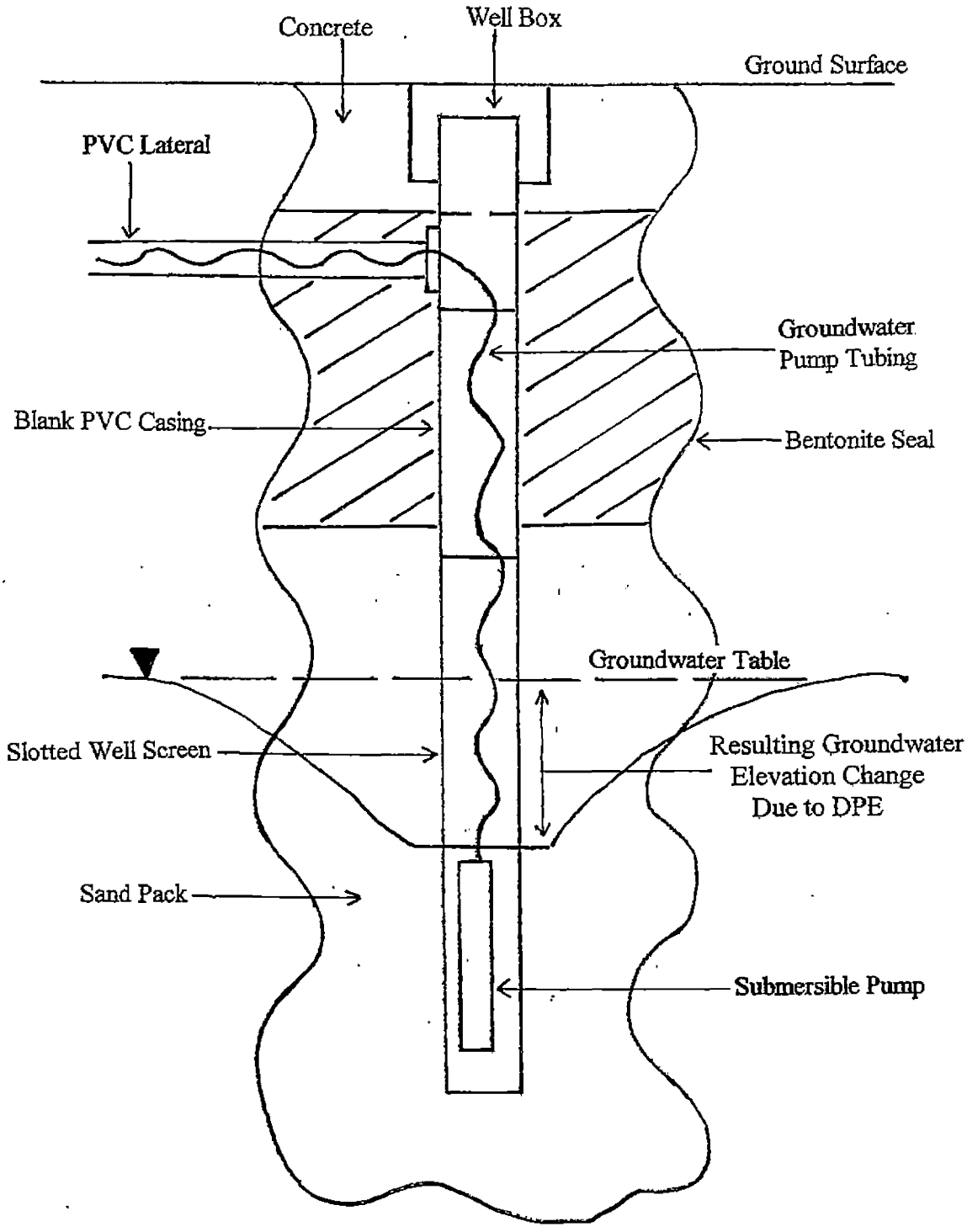
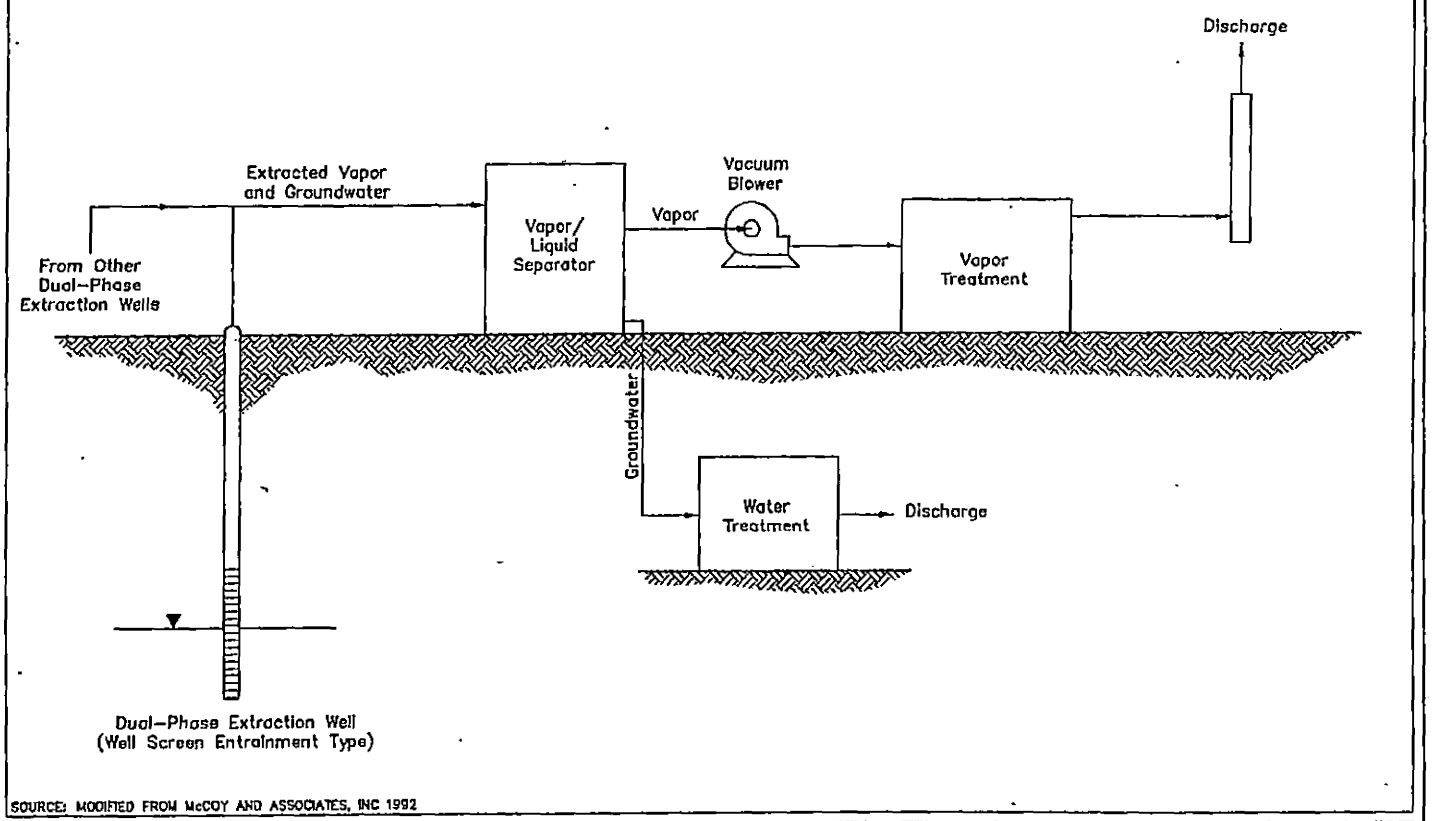


Figure 9

Schematic of Typical DPE System



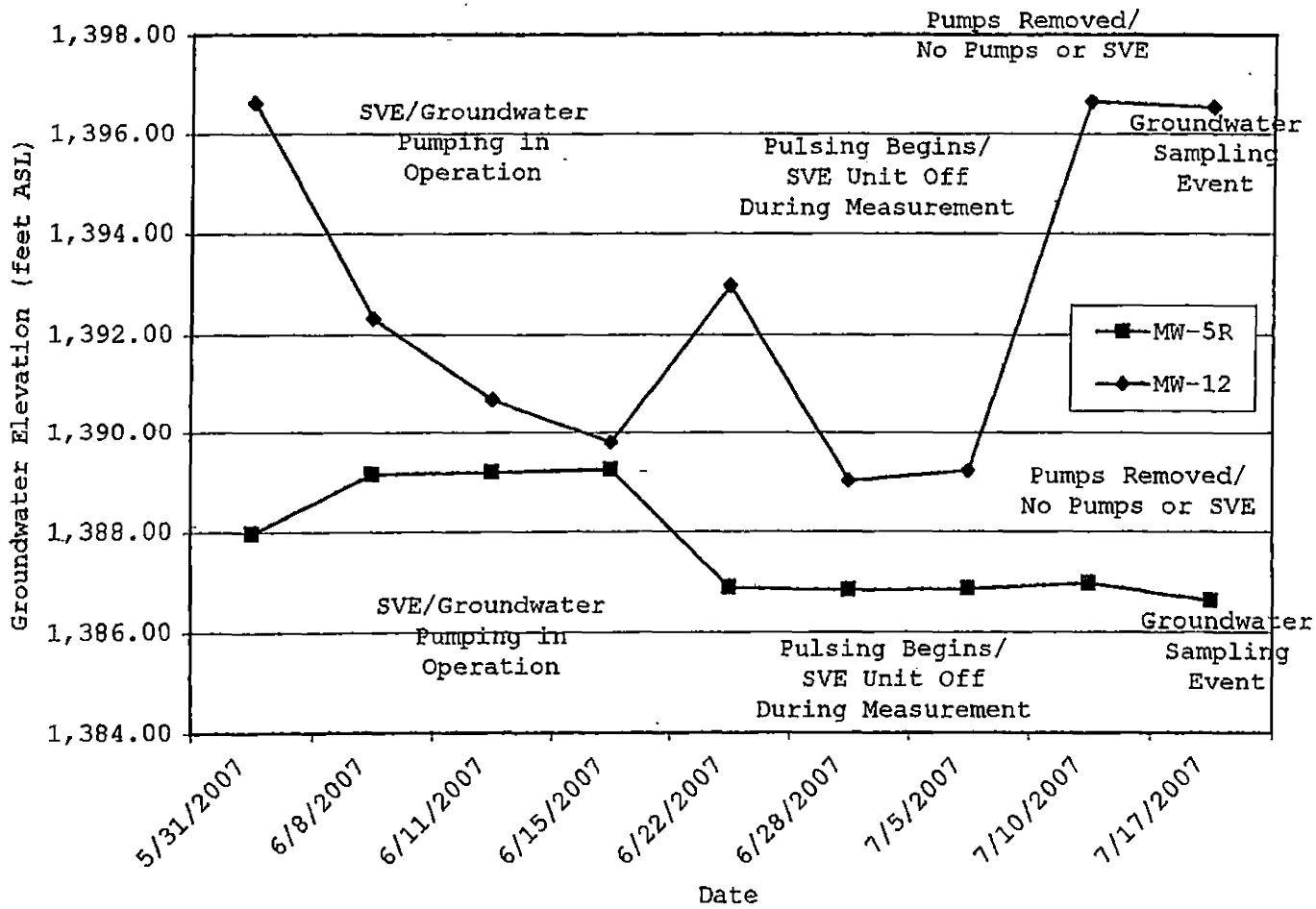
Source: "Analysis of Selected Enhancements for Soil Vapor Extraction," EPA, September 1997, Figure 4-1

Figure 10

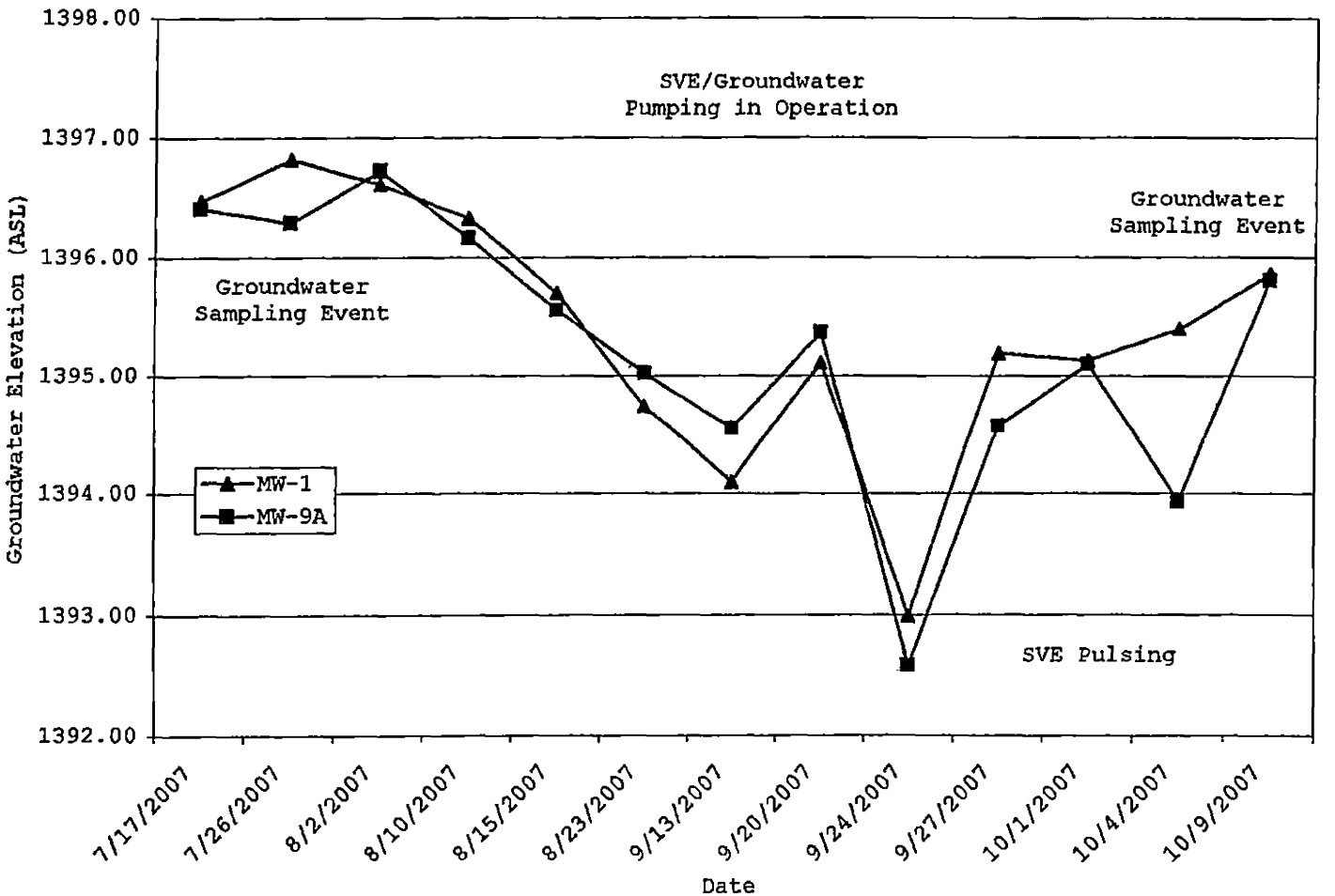
APPENDIX B

GRAPHS

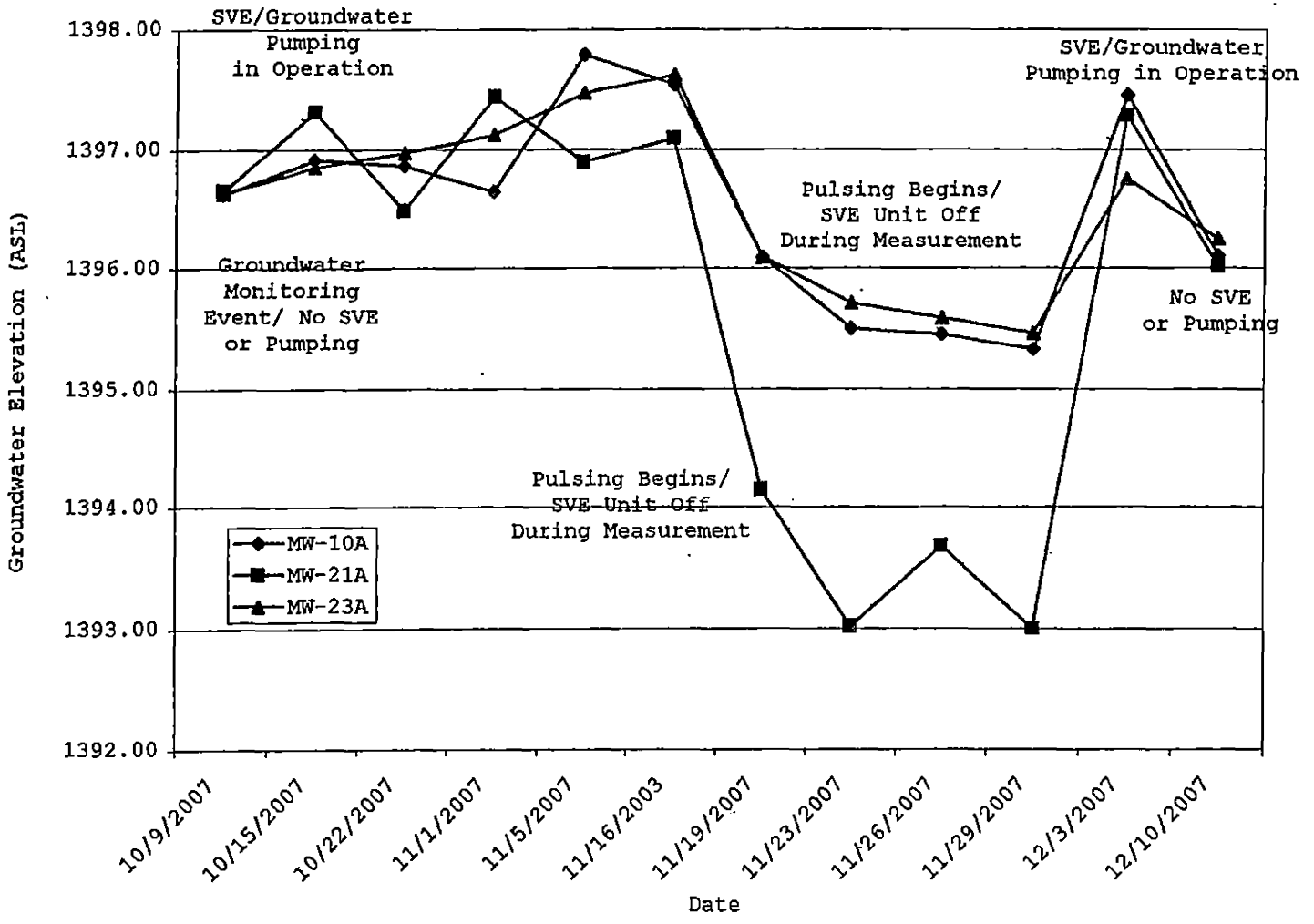
Graph 1
Groundwater Elevation Trends - Phase I



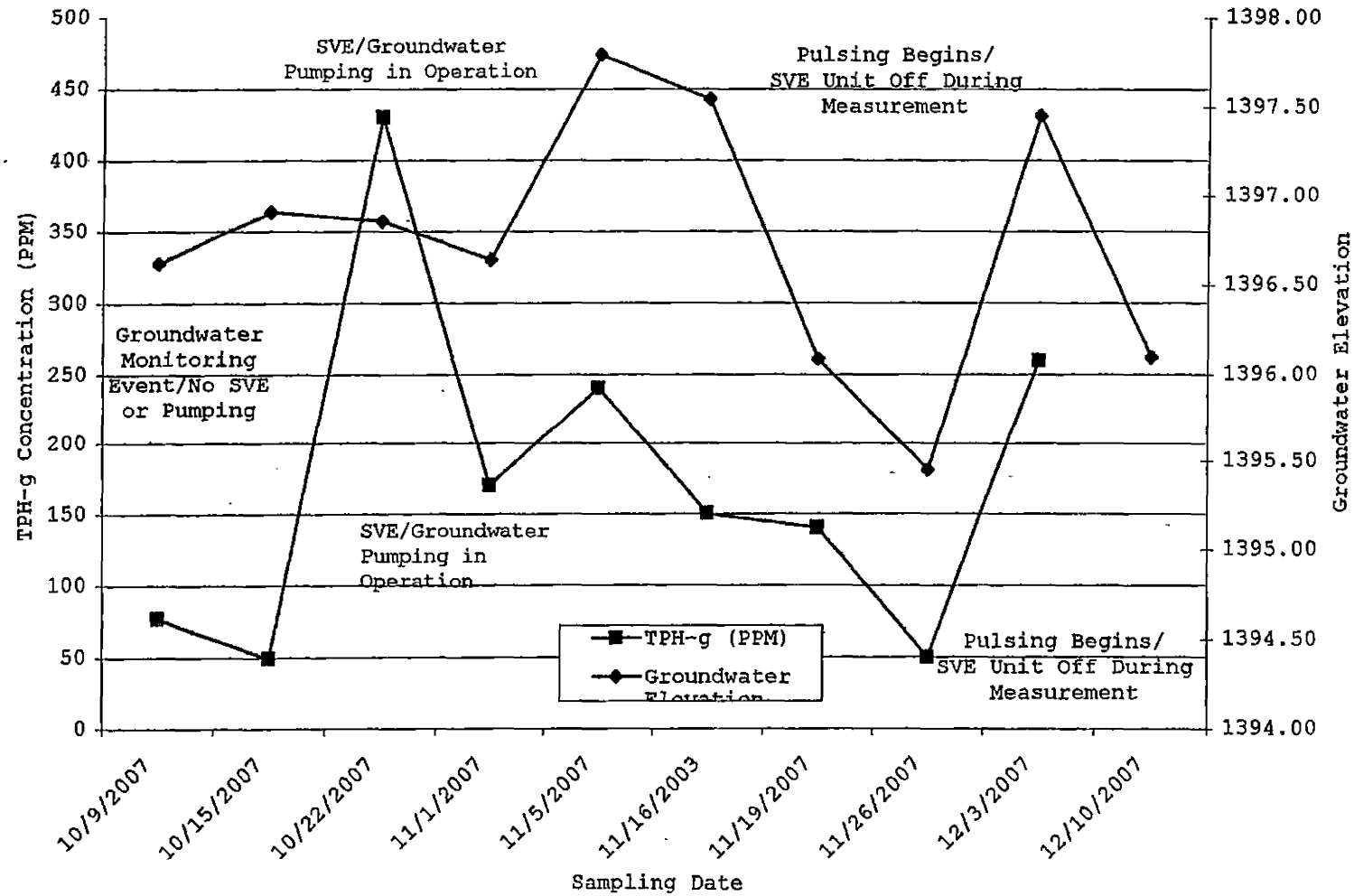
Graph 2
Groundwater Elevation Trends - Phase II



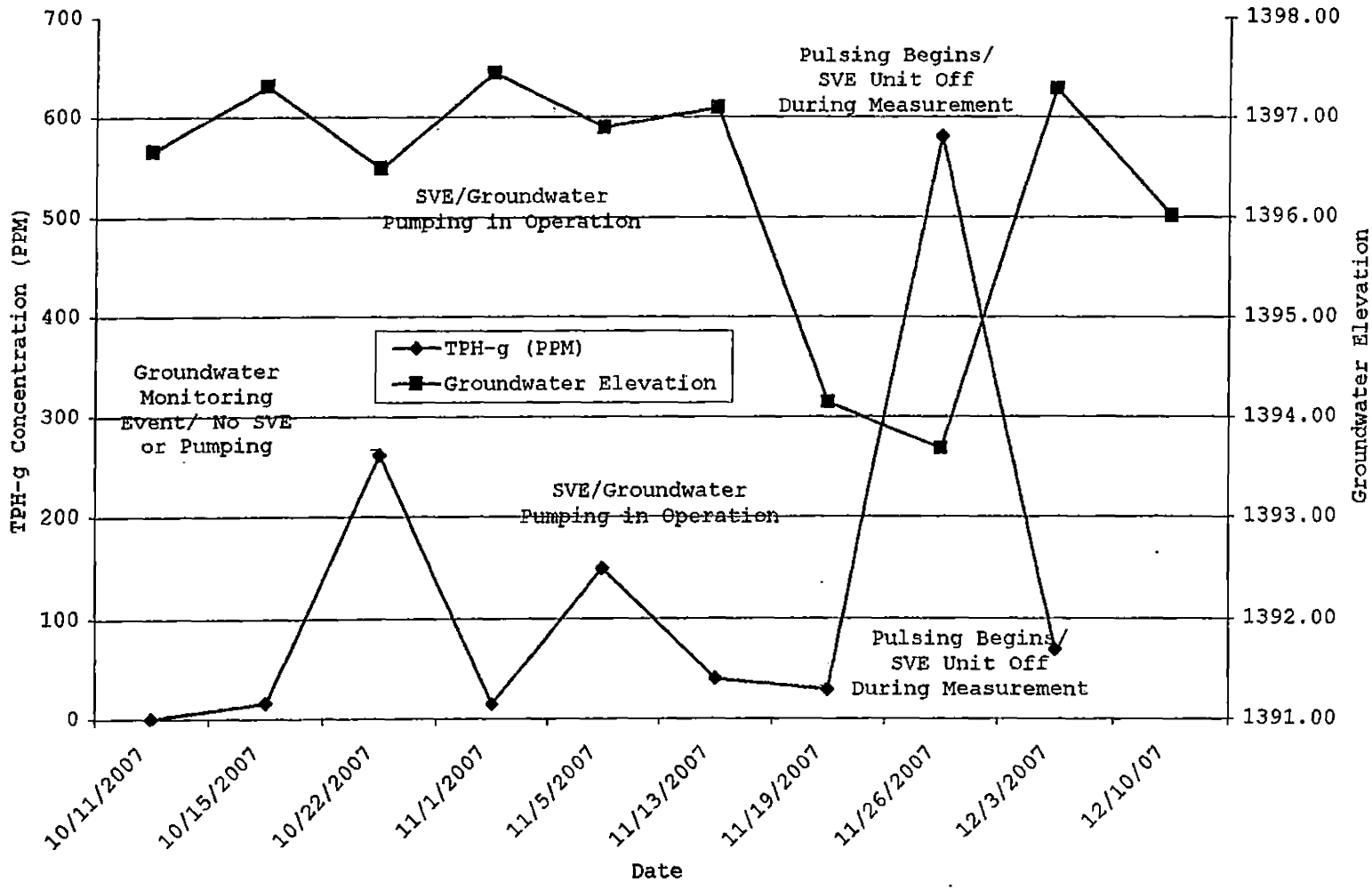
Graph 3
Groundwater Elevation Trends - Phase III



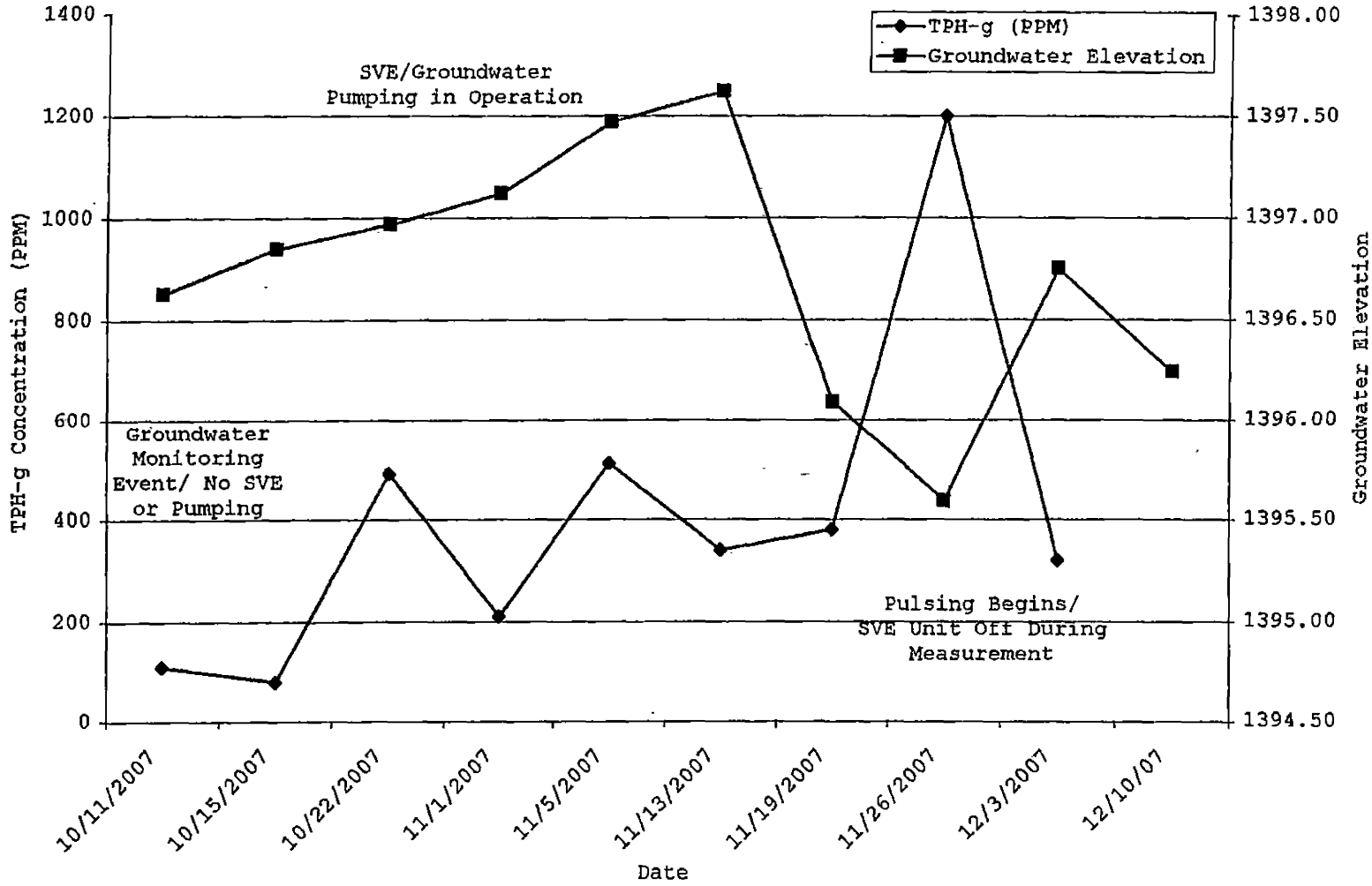
Graph 4A
TPH-g Concentration - Well MW-10A

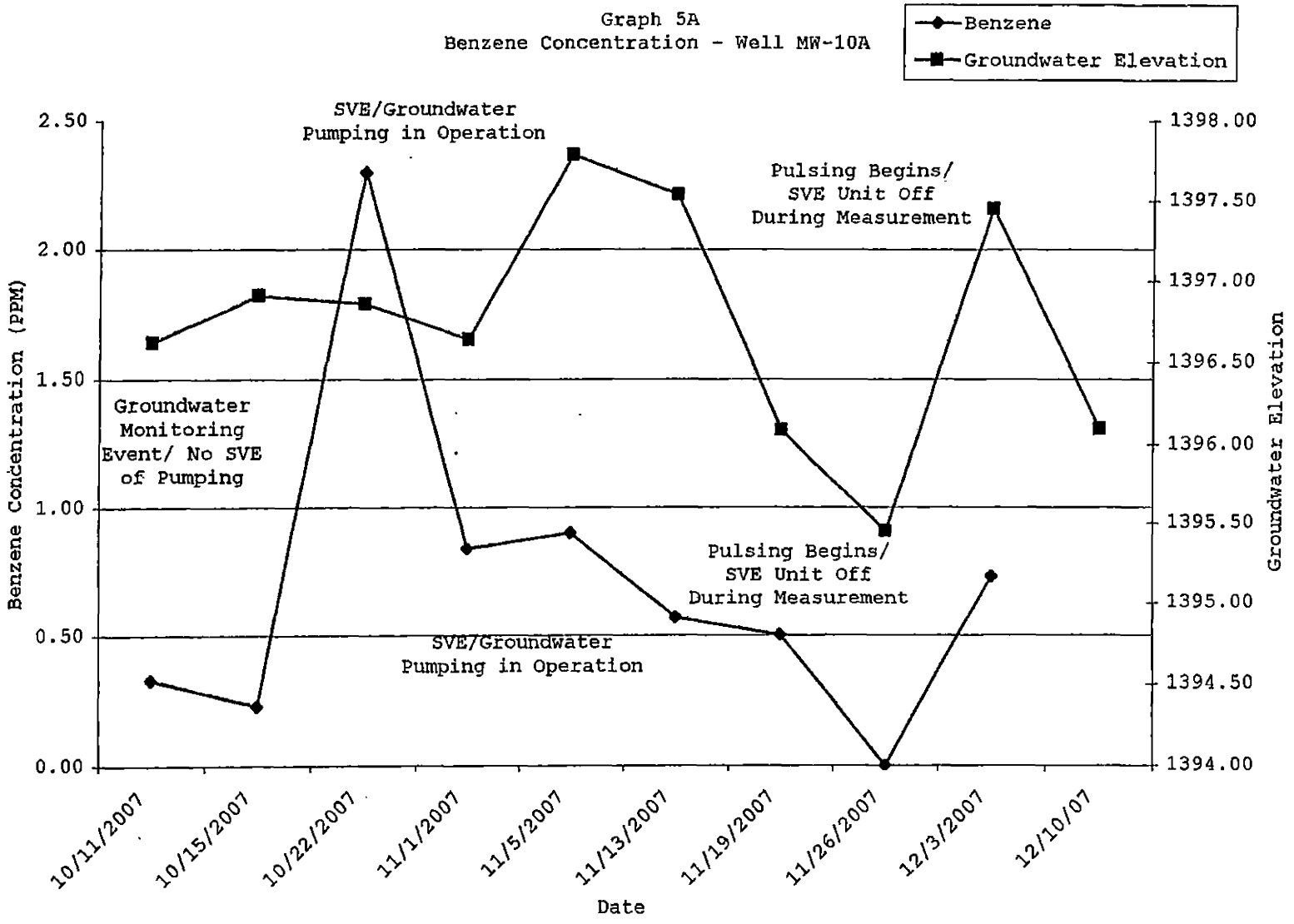


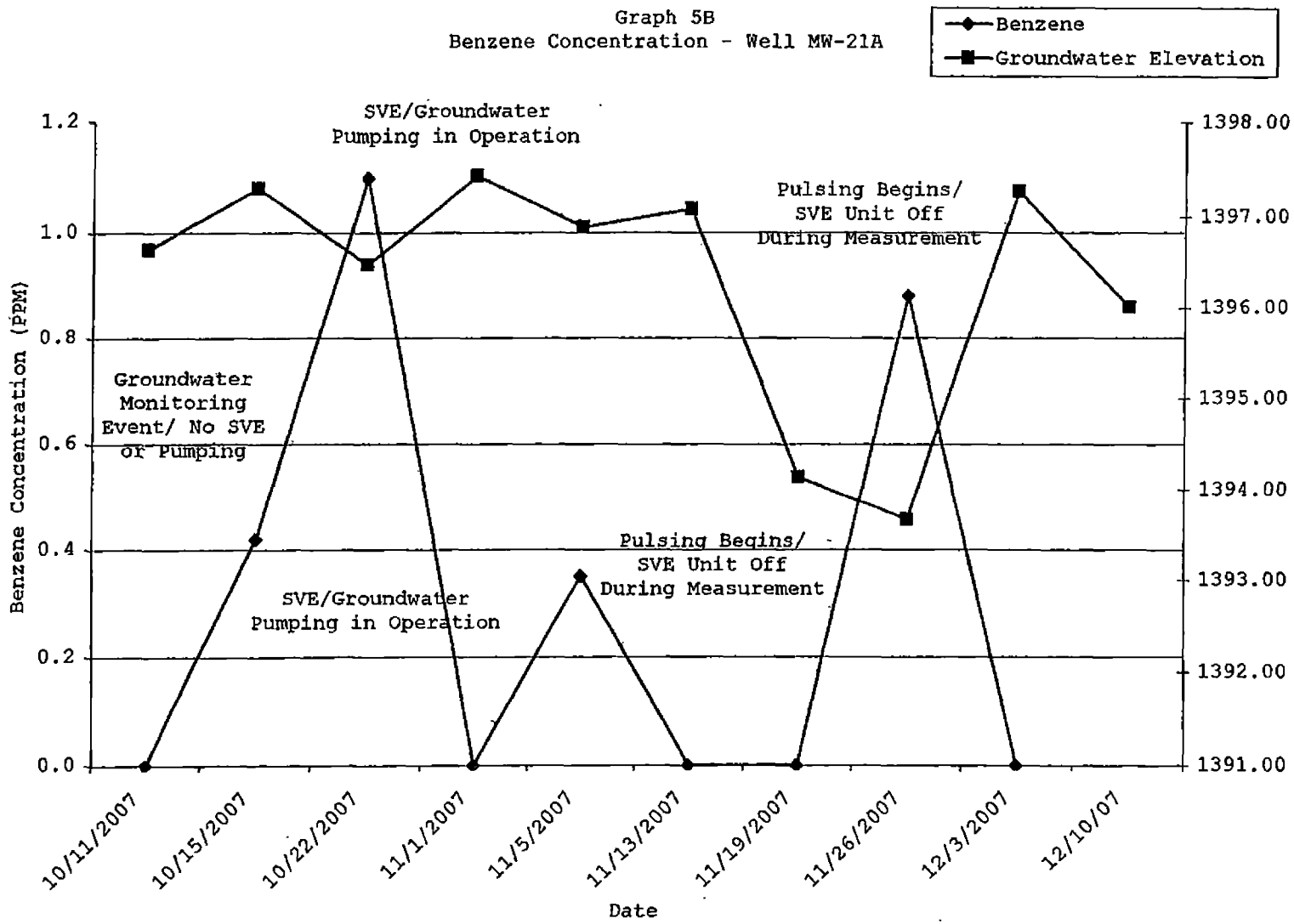
Graph 4B
TPH-g Concentration - Well MW-21A

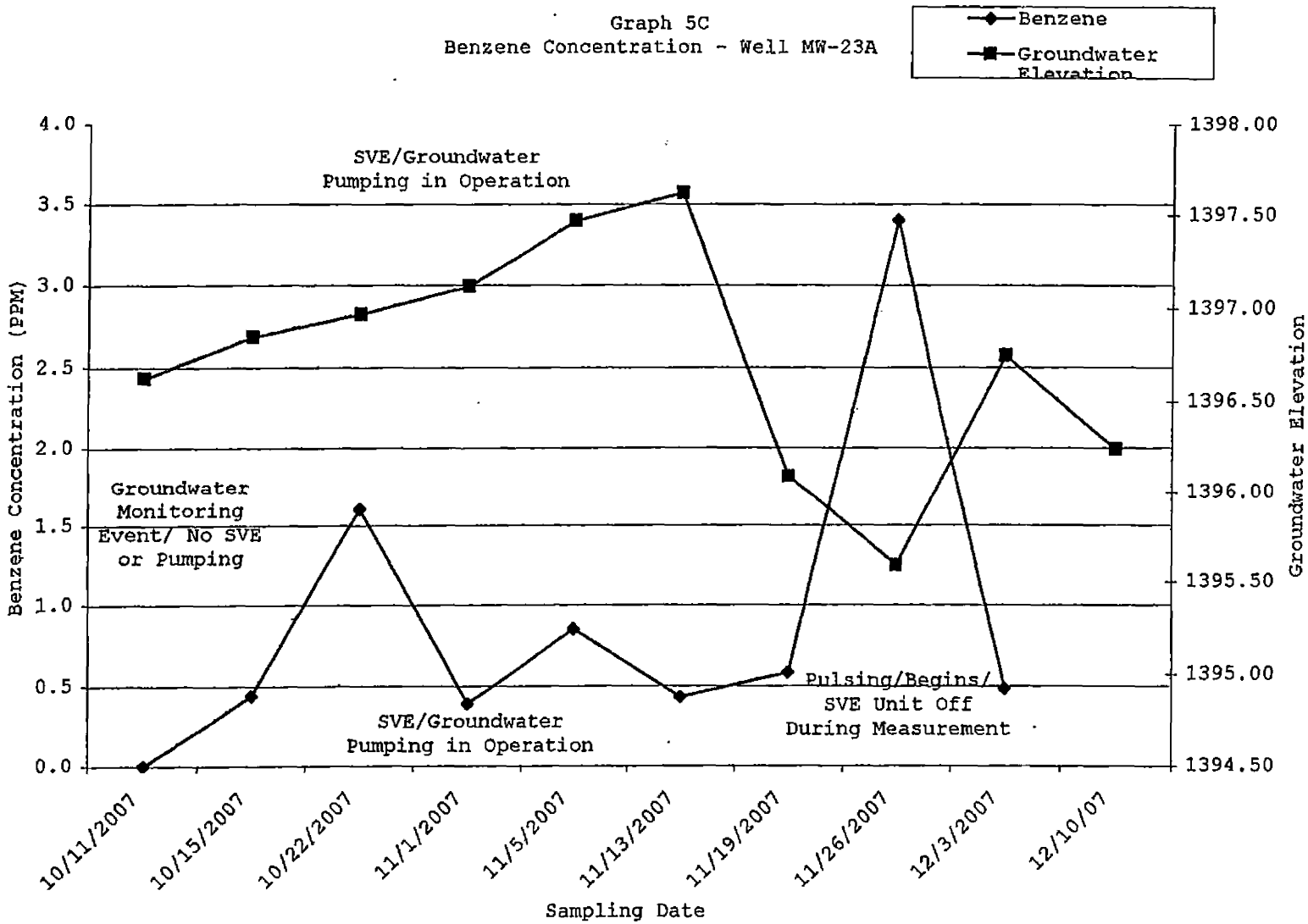


Graph 4C
TPH-g Concentration - Well MW-23A

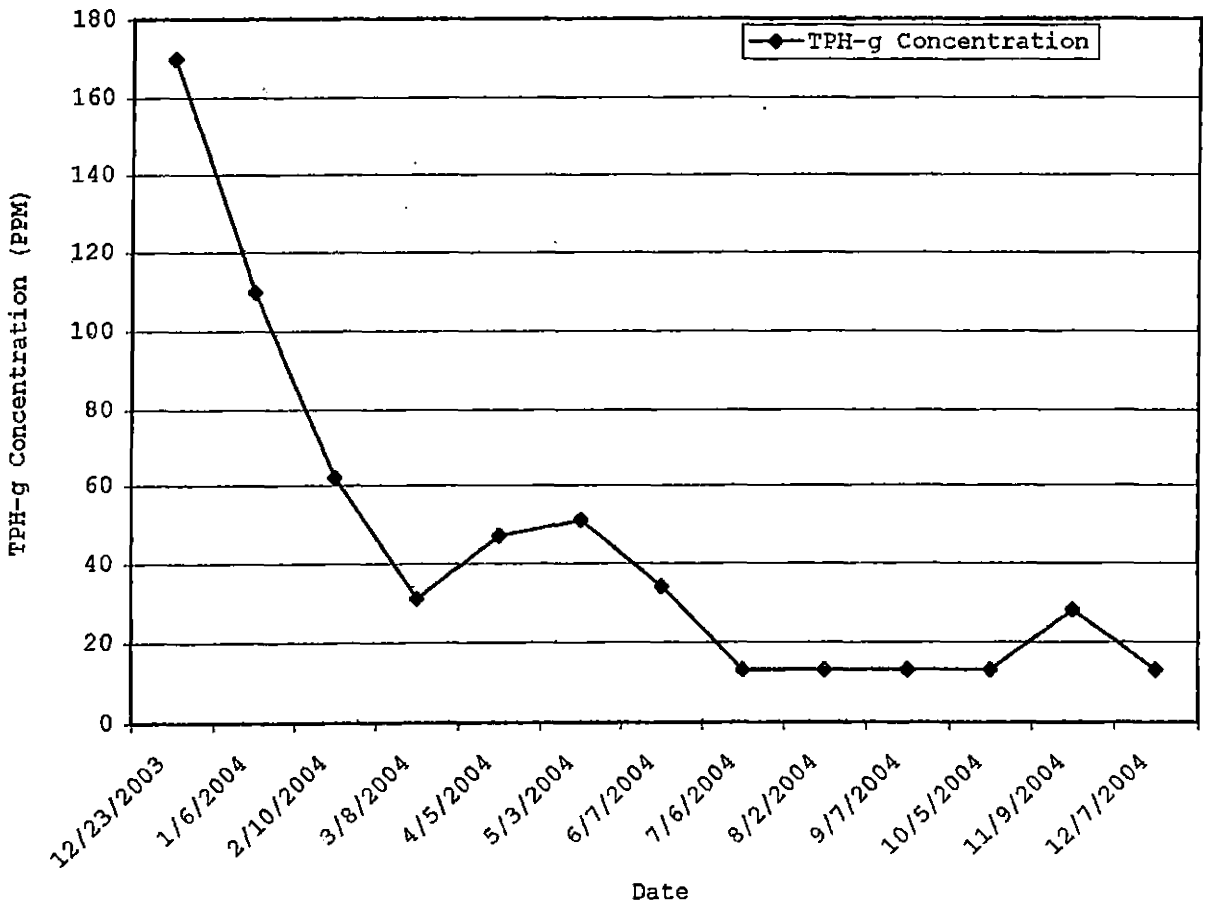



Graph 5A
Benzene Concentration - Well MW-10A
Benzene
Groundwater Elevation
SVE/Groundwater
Pumping in Operation
Pulsing Begins/
SVE Unit Off
During Measurement
Groundwater
Monitoring
Event/ No SVE
of Pumping
Pulsing Begins/
SVE Unit Off
During Measurement
SVE/Groundwater
Pumping in Operation
Benzene Concentration (PPM)
Groundwater Elevation
2.50
2.00
1.50
1.00
0.50
0.00
1398.00
1397.50
1397.00
1396.50
1396.00
1395.50
1395.00
1394.50
1394.00
10/11/2007
10/15/2007
10/22/2007
11/1/2007
11/5/2007
11/13/2007
11/19/2007
11/26/2007
12/3/2007
12/10/07
Date

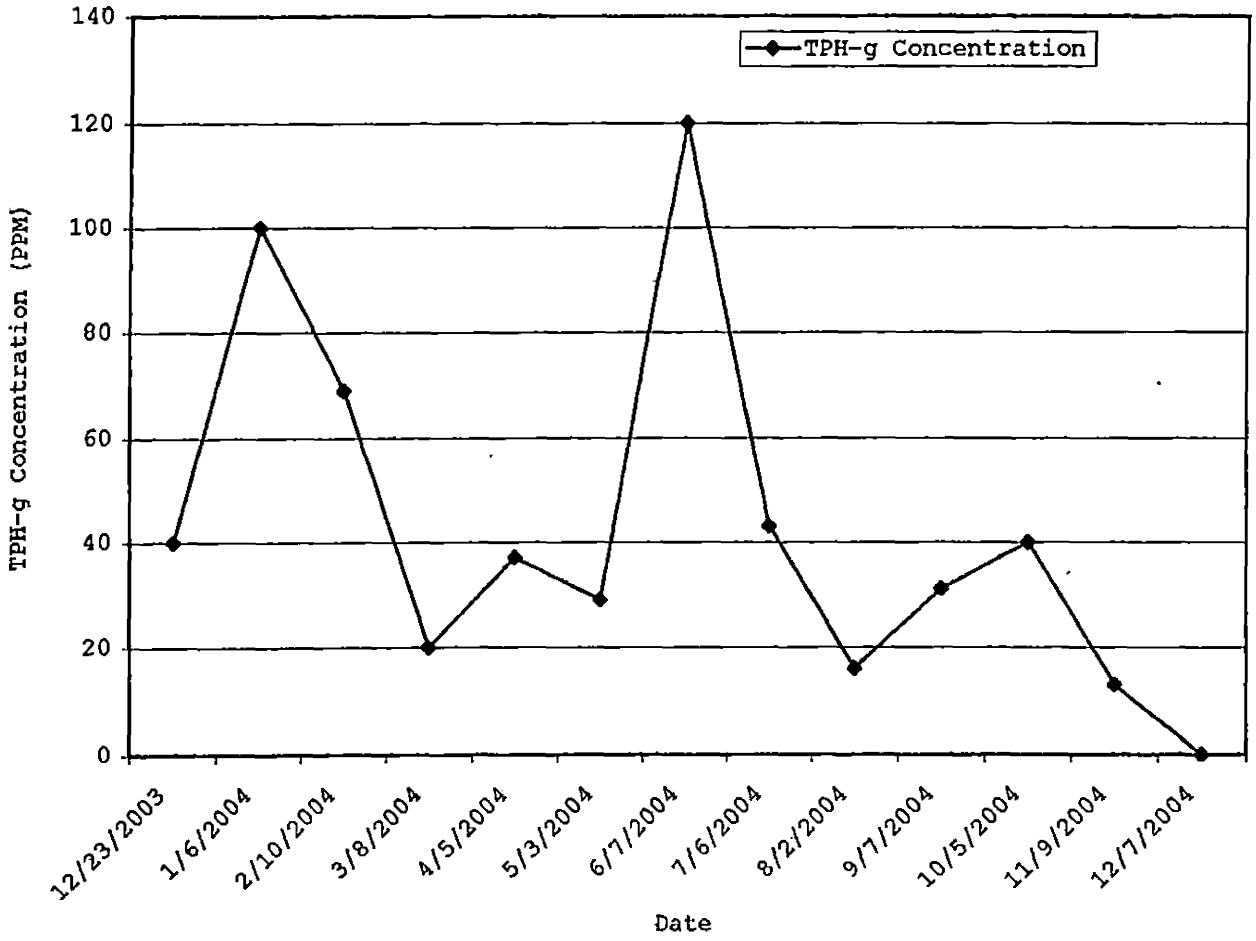

Graph 5B
Benzene Concentration - Well MW-21A
Benzene
Groundwater Elevation
SVE/Groundwater
Pumping in Operation
Pulsing Begins/
SVE Unit Off
During Measurement
Groundwater
Monitoring
Event/ No SVE
or Pumping
Pulsing Begins/
SVE Unit Off
During Measurement
SVE/Groundwater
Pumping in Operation
Benzene Concentration (PPM)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1398.00
1397.00
1396.00
1395.00
1394.00
1393.00
1392.00
1391.00
10/11/2007
10/15/2007
10/22/2007
11/1/2007
11/5/2007
11/13/2007
11/19/2007
11/26/2007
12/3/2007
12/10/07
Date


Graph 5C
Benzene Concentration - Well MW-23A
Benzene
Groundwater Elevation
SVE/Groundwater Pumping in Operation
Groundwater Monitoring Event/ No SVE or Pumping
SVE/Groundwater Pumping in Operation
Pulsing/Begins/ SVE Unit Off During Measurement
Benzene Concentration (PPM)
Groundwater Elevation
Sampling Date
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1398.00
1397.50
1397.00
1396.50
1396.00
1395.50
1395.00
1394.50
10/11/2007
10/15/2007
10/22/2007
11/1/2007
11/5/2007
11/13/2007
11/19/2007
11/26/2007
12/3/2007
12/10/07

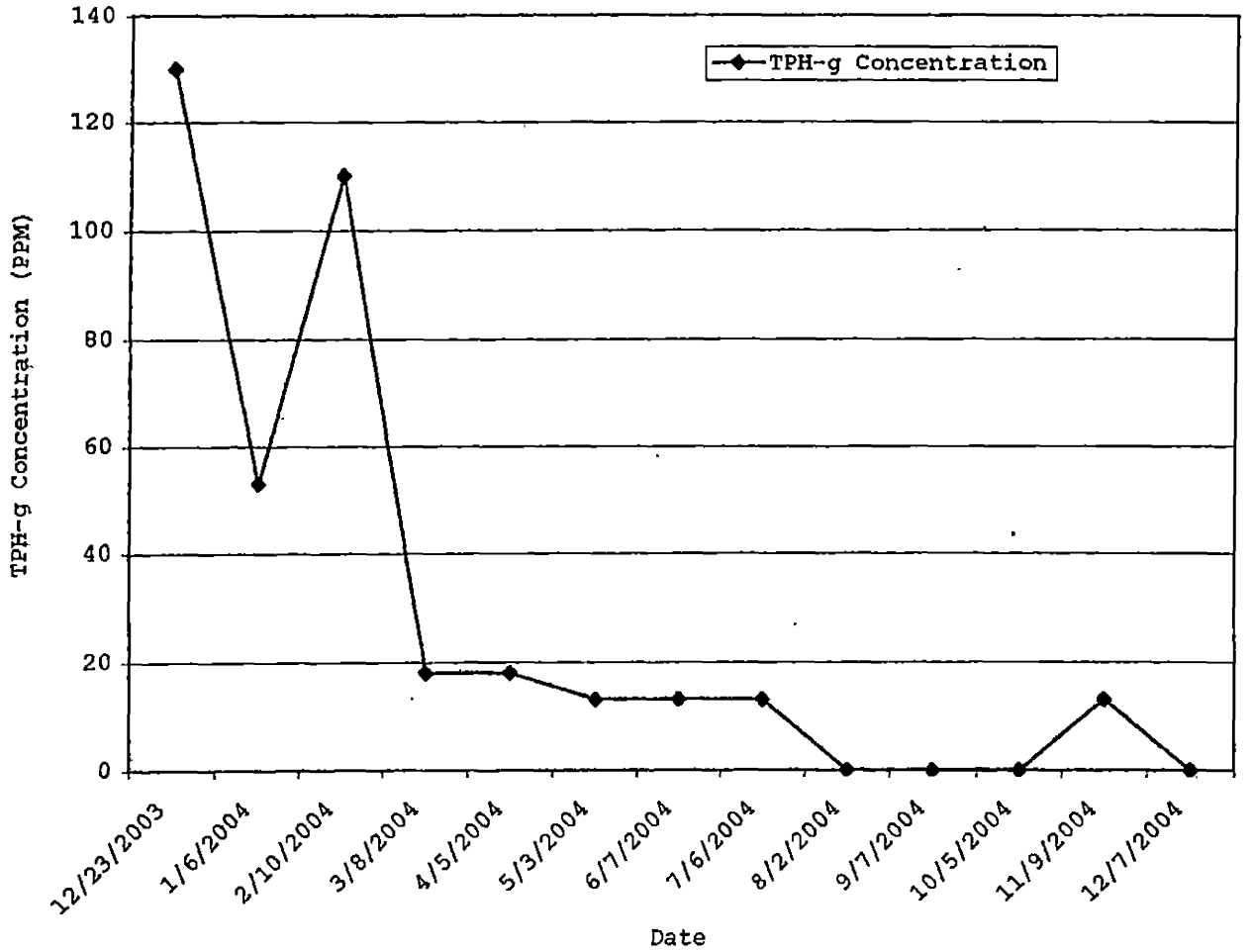
Graph 6A
Previous TPH-g Concentration - Well 10A



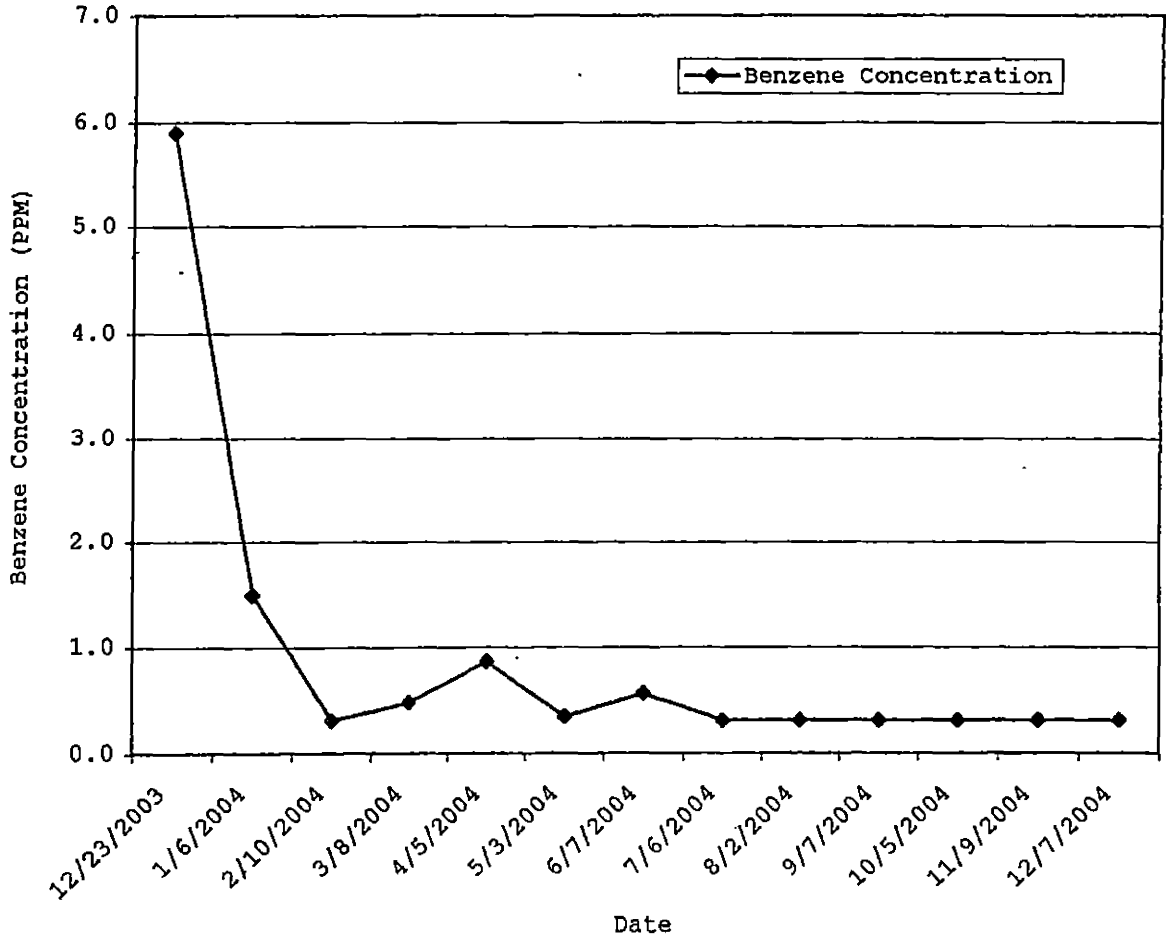
Graph 6B
Previous TPH-g Concentrations - Well MW-21A



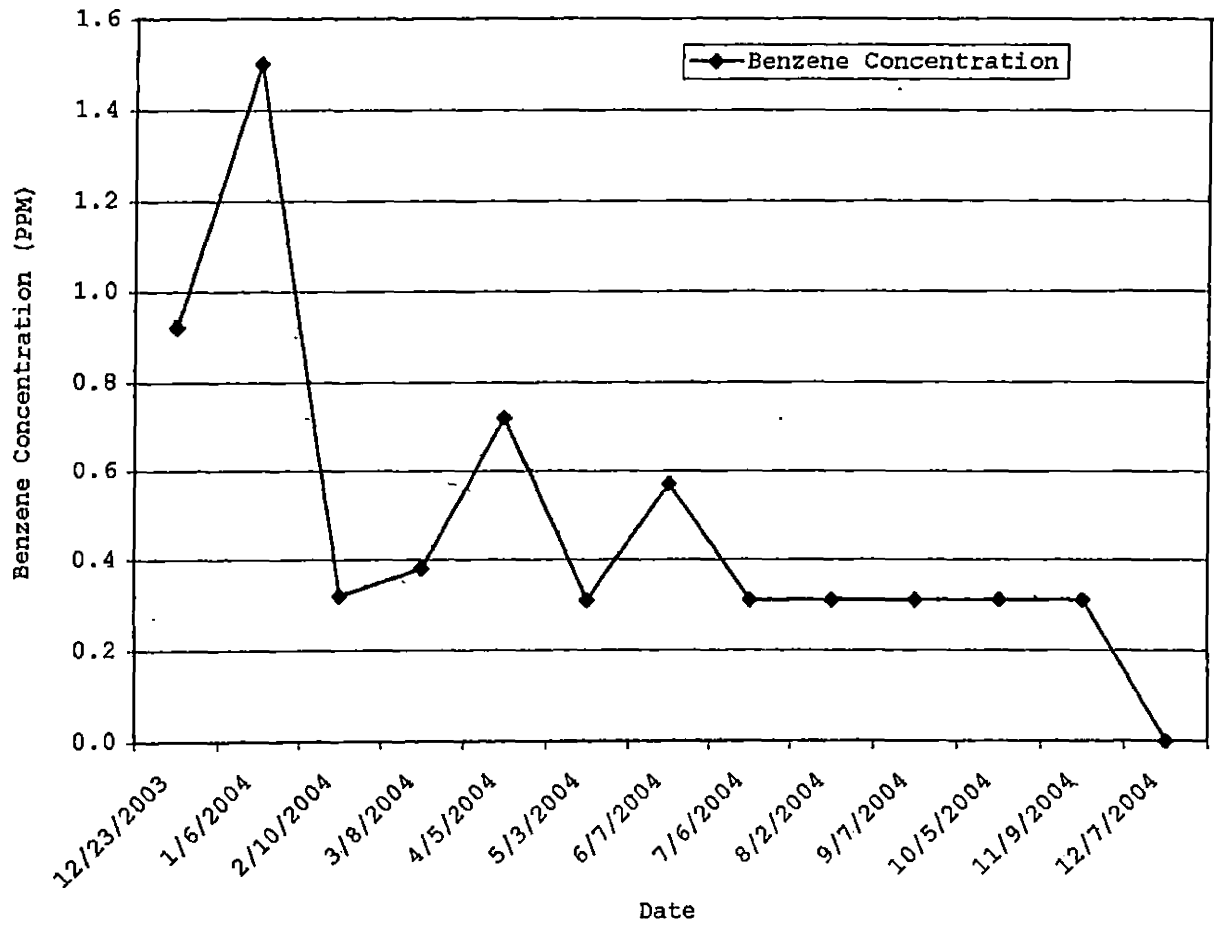
Graph 6C
Previous TPH-g Concentration - Well MW-23A



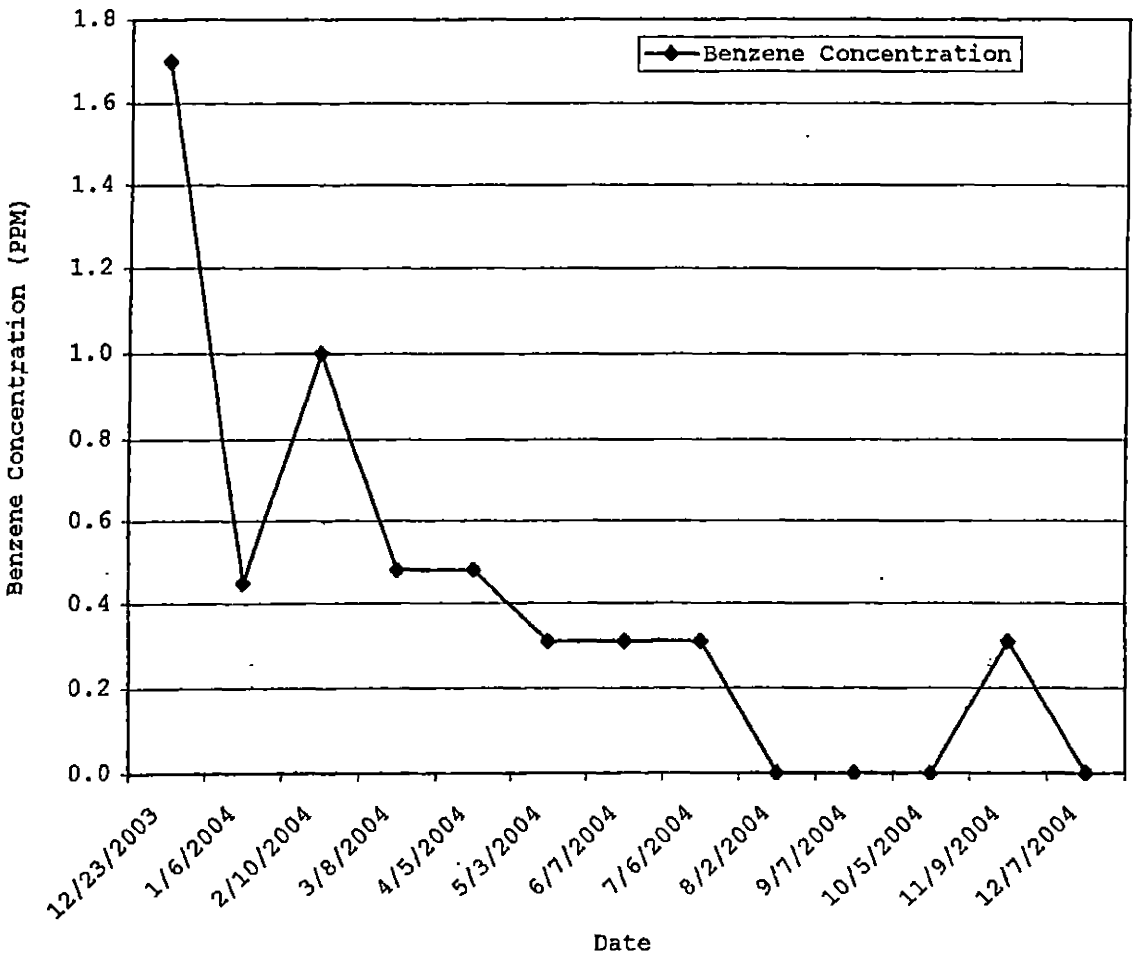
Graph 7A
Previous Benzene Concentration - Well MW-10A



Graph 7B
Previous Benzene Concentration - Well MW-21A



Graph 7C
Previous Benzene Concentration - Well MW-23A



APPENDIX C

SUPPLEMENTAL TABLES

TABLE 1

SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - EPA METHODS 8015-g/8260 - TPH-g/BTEX/Oxygenates

Sun City SOCO

SVE Vapor Results

Well #	Sampling Date	Phase of Project	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 (mg/L)	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 ppm(v/v)	Benzene EPA 8260 (ug/L)	Benzene EPA 8260 ppm(v/v)	Toluene EPA 8260 (ug/L)	Toluene EPA 8260 ppm(v/v)	Ethylbenzene EPA 8260 (ug/L)	Ethylbenzene EPA 8260 ppm(v/v)	Total Xylenes EPA 8260 (ug/L)	Total Xylenes EPA 8260 ppm(v/v)	MTBE EPA 8260 (ug/L)	MTBE EPA 8260 ppm(v/v)
SVE-1	04/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	2.2	0.62
"	04/30/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/04/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/11/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/18/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/02/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/09/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
MW-5R	04/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	4.4	1.2
"	04/30/07	Phase I	ND(0.06)	ND(13)	1.2	0.37	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/04/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/11/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/18/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/02/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/09/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	1.3	0.36	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
MW-11	04/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	04/30/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/04/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/11/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/18/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/02/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/09/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
MW-12	04/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	04/30/07	Phase I	0.06	13	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/04/07	Phase I	0.07	14	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/11/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	06/18/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	3.3	0.77	ND(1.0)	ND(0.28)
"	06/25/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/02/07	Phase I	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/09/07	Phase I	0.07	14	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)

TABLE 1 (cont.)

SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - EPA METHODS 8015-g/8260 - TPH-g/BTEX/Oxygenates

Sun City SOCO

SVE Vapor Results

Well #	Sampling Date	Phase of Project	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 (mg/L)	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 ppm(v/v)	Benzene EPA 8260 (ug/L)	Benzene EPA 8260 ppm(v/v)	Toluene EPA 8260 (ug/L)	Toluene EPA 8260 ppm(v/v)	Ethylbenzene EPA 8260 (ug/L)	Ethylbenzene EPA 8260 ppm(v/v)	Total Xylenes EPA 8260 (ug/L)	Total Xylenes EPA 8260 ppm(v/v)	MTBE EPA 8260 (ug/L)	MTBE EPA 8260 ppm(v/v)
MW-1	07/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/23/07	Phase II	0.08	18	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/30/07	Phase II	0.11	23	ND(1.0)	ND(0.31)	1.7	0.45	ND(1.0)	ND(0.23)	3.1	0.71	ND(1.0)	ND(0.28)
"	08/06/07	Phase II	0.14	31	ND(1.0)	ND(0.31)	2.8	0.73	ND(1.0)	ND(0.23)	7.8	1.75	ND(1.0)	ND(0.28)
"	08/13/07	Phase II	0.24	51	ND(1.0)	ND(0.31)	6.2	1.60	2.2	0.52	15.9	3.69	ND(1.0)	ND(0.28)
"	08/20/07	Phase II	0.47	100	ND(1.0)	ND(0.31)	9.0	2.10	2.9	0.66	15.2	3.53	ND(1.0)	ND(0.28)
"	08/27/07	Phase II	0.14	30	ND(1.0)	ND(0.31)	2.3	0.62	ND(1.0)	ND(0.23)	5.8	1.30	ND(1.0)	ND(0.28)
"	09/04/07	Phase II	0.07	14	ND(1.0)	ND(0.31)	1.2	0.32	ND(1.0)	ND(0.23)	9.3	2.18	ND(1.0)	ND(0.28)
"	09/10/07	Phase II	0.09	18	ND(1.0)	ND(0.31)	1.2	0.32	ND(1.0)	ND(0.23)	8.7	2.06	ND(1.0)	ND(0.28)
"	09/17/07	Phase II	0.10	22	ND(1.0)	ND(0.31)	1.2	0.32	ND(1.0)	ND(0.23)	7.4	1.69	ND(1.0)	ND(0.28)
"	09/27/07	Phase II	0.26	56	ND(1.0)	ND(0.31)	3.2	0.85	2.6	0.59	24.6	5.70	ND(1.0)	ND(0.28)
"	10/04/07	Phase II	0.39	83	ND(1.0)	ND(0.31)	3.9	1.00	3.1	0.71	31.0	7.10	ND(1.0)	ND(0.28)
MW-2	07/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/23/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/30/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/06/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/13/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/20/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/27/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/04/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/10/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/27/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	10/04/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)

TABLE 1 (cont.)

SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - EPA METHODS 8015-g/8260 - TPH-g/BTEX/Oxygenates

Sun City SOCO

SVE Vapor Results

Well #	Sampling Date	Phase of Project	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 (mg/L)	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 ppm(v/v)	Benzene EPA 8260 (ug/L)	Benzene EPA 8260 ppm(v/v)	Toluene EPA 8260 (ug/L)	Toluene EPA 8260 ppm(v/v)	Ethylbenzene EPA 8260 (ug/L)	Ethylbenzene EPA 8260 ppm(v/v)	Total Xylenes EPA 8260 (ug/L)	Total Xylenes EPA 8260 ppm(v/v)	MTBE EPA 8260 (ug/L)	MTBE EPA 8260 ppm(v/v)
MW-9A	07/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/23/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/30/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/06/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/13/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/20/07	Phase II	0.25	53	ND(1.0)	ND(0.31)	4.6	1.2	2.4	0.55	15.2	3.43	ND(1.0)	ND(0.28)
"	08/27/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	2.9	0.67	ND(1.0)	ND(0.28)
"	09/04/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	2.4	0.54	ND(1.0)	ND(0.28)
"	09/10/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/27/07	Phase II	0.08	18	ND(1.0)	ND(0.31)	1.6	0.44	1.1	0.26	8.9	2.06	ND(1.0)	ND(0.28)
"	10/04/07	Phase II	0.16	34	ND(1.0)	ND(0.31)	2.3	0.62	1.6	0.38	16.2	3.77	ND(1.0)	ND(0.28)
MW-17A	07/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/23/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	07/30/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/06/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/13/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	08/20/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	1.6	0.43	ND(1.0)	ND(0.23)	2.4	0.56	ND(1.0)	ND(0.28)
"	08/27/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/04/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/10/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/17/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	09/27/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	10/04/07	Phase II	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)

TABLE 1 (cont.)

SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - EPA METHODS 8015-g/8260 - TPH-g/BTEX/Oxygenates

Sun City SOCO

SVE Vapor Results

Well #	Sampling Date	Phase of Project	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 (mg/L)	Total Volatile Hydrocarbons as Gasoline (TPH-g) EPA 8015 ppm(v/v)	Benzene EPA 8260 (ug/L)	Benzene EPA 8260 ppm(v/v)	Toluene EPA 8260 (ug/L)	Toluene EPA 8260 ppm(v/v)	Ethylbenzene EPA 8260 (ug/L)	Ethylbenzene EPA 8260 ppm(v/v)	Total Xylenes EPA 8260 (ug/L)	Total Xylenes EPA 8260 ppm(v/v)	MTBE EPA 8260 (ug/L)	MTBE EPA 8260 ppm(v/v)
MW-18A	10/11/07	Phase III	0.36	77	1.1	0.33	1.5	0.40	ND(1.0)	ND(0.23)	7.2	1.7	ND(1.0)	ND(0.28)
"	10/15/07	Phase III	0.23	49	0.72	0.23	2.9	0.77	ND(1.0)	ND(0.23)	4.6	1.07	ND(1.0)	ND(0.28)
"	10/22/07	Phase III	2.00	430	7.3	2.3	29	7.8	4.1	0.94	24.3	5.6	ND(1.0)	ND(0.28)
"	11/01/07	Phase III	0.78	170	2.7	0.84	17	4.6	2.5	0.59	24.9	5.9	ND(1.0)	ND(0.28)
"	11/05/07	Phase III	1.10	240	2.9	0.9	13	3.6	1.4	0.32	11.2	2.61	ND(1.0)	ND(0.28)
"	11/13/07	Phase III	0.68	150	1.8	0.57	15	4.0	2.4	0.56	23.2	5.4	ND(1.0)	ND(0.28)
"	11/19/07	Phase III	0.64	140	1.6	0.50	16	4.2	2.9	0.67	39.0	9.0	ND(1.0)	ND(0.28)
"	11/26/07	Phase III	0.25	50	ND(1.0)	ND(0.31)	3.3	0.87	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	12/03/07	Phase III	1.20	260	2.3	0.73	23	6.0	4.2	0.97	50	11.7	ND(1.0)	ND(0.28)
MW-21A	10/11/07	Phase III	ND(0.06)	ND(13)	ND(1.0)	ND(0.31)	ND(1.0)	ND(0.27)	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	10/15/07	Phase III	0.07	16	1.4	0.42	5.8	1.5	ND(1.0)	ND(0.23)	3.5	0.79	ND(1.0)	ND(0.28)
"	10/22/07	Phase III	1.20	260	3.5	1.1	22	5.8	5.0	1.2	23.0	5.2	ND(1.0)	ND(0.28)
"	11/01/07	Phase III	0.07	15	ND(1.0)	ND(0.31)	1.7	0.46	ND(1.0)	ND(0.23)	ND(2.0)	ND(0.46)	ND(1.0)	ND(0.28)
"	11/05/07	Phase III	0.70	150	1.1	0.35	9.7	2.6	1.9	0.44	9.5	2.16	ND(1.0)	ND(0.28)
"	11/13/07	Phase III	0.18	40	ND(1.0)	ND(0.31)	5.0	1.3	2.2	0.51	10.2	2.32	ND(1.0)	ND(0.28)
"	11/19/07	Phase III	0.14	29	ND(1.0)	ND(0.31)	4.6	1.2	1.4	0.32	11.2	2.54	ND(1.0)	ND(0.28)
"	11/26/07	Phase III	2.70	580	2.8	0.88	15	4.1	1.3	0.31	7.2	1.65	ND(1.0)	ND(0.28)
"	12/03/07	Phase III	0.32	69	ND(1.0)	ND(0.31)	8.8	2.3	2.3	0.52	14.3	3.36	ND(1.0)	ND(0.28)
MW-23A	10/11/07	Phase III	0.50	110	ND(1.0)	ND(0.31)	2.8	0.74	ND(1.0)	ND(0.23)	8.0	1.85	ND(1.0)	ND(0.28)
"	10/15/07	Phase III	0.37	80	1.4	0.44	4.5	1.20	ND(1.0)	ND(0.23)	4.4	1.02	ND(1.0)	ND(0.28)
"	10/22/07	Phase III	2.30	490	5.1	1.6	33	8.8	6.3	1.4	37.5	8.6	ND(1.0)	ND(0.28)
"	11/01/07	Phase III	0.98	210	1.2	0.39	11	2.9	1.5	0.34	14.1	3.11	ND(1.0)	ND(0.28)
"	11/05/07	Phase III	2.40	510	2.7	0.85	18	4.7	1.7	0.39	13.6	3.1	ND(1.0)	ND(0.28)
"	11/13/07	Phase III	1.6	340	1.4	0.43	15	4.0	1.7	0.40	18.8	4.27	ND(1.0)	ND(0.28)
"	11/19/07	Phase III	1.8	380	1.8	0.58	20	5.4	4.2	0.96	70	16.0	ND(1.0)	ND(0.28)
"	11/26/07	Phase III	5.4	1,200	11	3.4	47	13	5.7	1.3	76	17.2	ND(1.0)	ND(0.28)
"	12/03/07	Phase III	1.5	320	1.5	0.48	18	4.9	4.1	0.95	56	12.8	ND(1.0)	ND(0.28)

TABLE 2
SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - Oxygenates - EPA METHOD 8260B
Sun City SOCO
SVE Vapor Results
Units = ug/L of air

Well #	Sampling Date	Phase of Project	TAME	TBA	DIPE	EtBE	MTBE
SVE-1	04/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	2.2
"	04/30/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/04/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/11/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/18/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/02/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/09/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-5R	04/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	4.4
"	04/30/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/04/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/11/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/18/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/02/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/09/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-11	04/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	04/30/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/04/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/11/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/18/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/02/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/09/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-12	04/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	04/30/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/04/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/11/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/18/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	06/25/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/02/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/09/07	Phase I	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)

TABLE 2
SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - Oxygenates - EPA METHOD 8260B
Sun City SOCO
SVE Vapor Results
Units = ug/L of air

Well #	Sampling Date	Phase of Project	TAME	TBA	DIPE	EtBE	MTBE
MW-1	07/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/23/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/30/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/06/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/13/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/20/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/10/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-2	07/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/23/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/30/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/06/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/13/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/20/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/10/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)

TABLE 2
SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - Oxygenates - EPA METHOD 8260B
Sun City SOCO
SVE Vapor Results
Units = ug/L of air

Well #	Sampling Date	Phase of Project	TAME	TBA	DIPE	EtBE	MTBE
MW-9A	07/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/23/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/30/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/06/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/13/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/20/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/10/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-17A	07/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/23/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	07/30/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/06/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/13/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/20/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	08/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/10/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/17/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	09/27/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/04/07	Phase II	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)

TABLE 2
SUMMARY OF SOIL VAPOR ANALYTICAL RESULTS - Oxygenates - EPA METHOD 8260B
Sun City SOCO
SVE Vapor Results
Units = ug/L of air

Well #	Sampling Date	Phase of Project	TAME	TBA	DIPE	EtBE	MTBE
MW-10A	10/11/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/15/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/22/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/01/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/05/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/13/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/19/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/26/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	12/03/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-21A	10/11/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/15/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/22/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/01/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/05/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/13/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/19/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/26/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	12/03/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
MW-23A	10/11/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/15/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	10/22/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/01/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/05/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/13/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/19/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	11/26/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)
"	12/03/07	Phase III	ND(1.0)	ND(10)	ND(1.0)	ND(1.0)	ND(1.0)

TABLE 3A
Soil Vapor Extraction Totals
WEEKLY SUMMARY OF DETECTED AND REMOVED TPH-g, BTEX, MTBE AND TAME
Former Sun City SoCo
Phase I

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	4/22 - 4/28/07	28	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	2.2	0.00	0.00	0.00	0.00	0.00	0.04
MW-5R		39	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	4.4	0.00	0.00	0.00	0.00	0.00	0.11
MW-11		24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		40	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.00	0.00	0.00	0.00	0.00	0.15

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	4/29 - 5/5/07	28	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		39	ND(0.06)	1.2	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.03	0.00	0.00	0.00	0.00
MW-11		24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		40	0.06	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	1.51	0.00	0.00	0.00	0.00	0.00
								Week Totals =	1.51	0.03	0.00	0.00	0.00	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
	5/6 - 6/2/07 Unit Shut down for Maintenance and Groundwater Extraction Pump Installation													

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	6/3 - 6/9/07	21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-11		20	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		30	0.07	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	1.32	0.00	0.00	0.00	0.00	0.00
								Week Totals =	1.32	0.00	0.00	0.00	0.00	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	6/10 - 6/16/07	20	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-11		21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.00	0.00	0.00	0.00	0.00	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	6/17 - 6/23/07	24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		34	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-11		24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	3.3	ND(1.0)	0.00	0.00	0.00	0.00	0.04	0.00
								Week Totals =	0.00	0.00	0.00	0.00	0.04	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	6/24 - 6/30/07	21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		34	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-11		21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 3A
Soil Vapor Extraction Totals
WEEKLY SUMMARY OF DETECTED AND REMOVED TPH-g, BTEX, MTBE AND TAME
Former Sun City SoCo
Phase I

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	7/1 - 7/7/2007	21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		36	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-11		21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.00	0.00	0.00	0.00	0.00	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
SVE-1	7/8 - 7/14/2007	21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-5R		36	ND(0.06)	ND(1.0)	1.3	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.02	0.00	0.00	0.00
MW-11		21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-12		32	0.07	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.80	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.80	0.00	0.02	0.00	0.00	0.00

Total recovered TPH-g (lbs)	Total recovered Benzene (lbs)	Total recovered Toluene (lbs)	Total recovered Ethylbenzene (lbs)	Total recovered Xylenes (lbs)	Total recovered MTBE
3.63	0.03	0.02	0.00	0.04	0.15

TABLE 3B
Soil Vapor Extraction Totals
WEEKLY SUMMARY OF DETECTED AND REMOVED TPH-g, BTEX, MTBE AND TAME
Former Sun City SoCo
Phase II

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	7/15 - 7/21/07	24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-2		28	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		18	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.00	0.00	0.00	0.00	0.00	0.00
Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	7/22 - 7/28/07	30	0.08	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	1.51	0.00	0.00	0.00	0.00	0.00
MW-2		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		24	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	1.51	0.00	0.00	0.00	0.00	0.00
Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	7/29 - 8/4/07	30	0.11	ND(1.0)	1.7	ND(1.0)	3.1	ND(1.0)	2.07	0.00	0.03	0.00	0.06	0.00
MW-2		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		22	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	2.07	0.00	0.03	0.00	0.06	0.00
Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	8/5 - 8/11/07	25	0.14	ND(1.0)	2.8	ND(1.0)	7.8	ND(1.0)	2.20	0.00	0.04	0.00	0.12	0.00
MW-2		31	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		31	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		21	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	2.20	0.00	0.04	0.00	0.12	0.00
Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	8/12 - 8/18/07	30	0.24	ND(1.0)	6.2	2.2	15.9	ND(1.0)	4.52	0.00	0.12	0.04	0.30	0.00
MW-2		34	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		32	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		25	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	4.52	0.00	0.12	0.04	0.30	0.00
Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	8/19 - 8/25/07	32	0.47	ND(1.0)	8.0	2.9	15.2	ND(1.0)	9.44	0.00	0.16	0.06	0.31	0.00
MW-2		34	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		30	0.25	ND(1.0)	4.6	2.4	15.2	ND(1.0)	4.71	0.00	0.09	0.05	0.29	0.00
MW-17A		26	ND(0.06)	ND(1.0)	1.6	ND(1.0)	2.4	ND(1.0)	0.00	0.00	0.03	0.00	0.04	0.00
								Week Totals =	16.15	0.00	0.27	0.10	0.63	0.00
Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	8/26 - 9/1/07	30	0.14	ND(1.0)	2.3	ND(1.0)	5.8	ND(1.0)	2.26	0.00	0.04	0.00	0.09	0.00
MW-2		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		29	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	2.8	ND(1.0)	0.00	0.00	0.00	0.00	0.05	0.00
MW-17A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	2.26	0.00	0.04	0.00	0.14	0.00

TABLE 3B
Soil Vapor Extraction Totals
WEEKLY SUMMARY OF DETECTED AND REMOVED TPH-g, BTEX, MTBE AND TAME
Former Sun City SoCo
Phase II

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	9/2 - 9/8/2007	30	0.07	ND(1.0)	1.2	ND(1.0)	9.3	ND(1.0)	0.26	0.00	0.00	0.00	0.04	0.00
MW-2		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	2.4	ND(1.0)	0.00	0.00	0.00	0.00	0.01	0.00
MW-17A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.26	0.00	0.00	0.00	0.05	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	9/9 - 9/15/2007	30	0.09	ND(1.0)	1.2	ND(1.0)	8.7	ND(1.0)	0.79	0.00	0.01	0.00	0.08	0.00
MW-2		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	0.79	0.00	0.01	0.00	0.09	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	9/16 - 9/22/2007	30	0.10	ND(1.0)	1.2	ND(1.0)	7.4	ND(1.0)	1.35	0.00	0.02	0.00	0.10	0.00
MW-2		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-17A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	1.35	0.00	0.02	0.00	0.10	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	9/23 - 9/29/2007	30	0.26	ND(1.0)	3.2	2.6	24.6	ND(1.0)	2.80	0.00	0.03	0.03	0.26	0.00
MW-2		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		30	0.08	ND(1.0)	1.6	1.1	9.9	ND(1.0)	0.86	0.00	0.02	0.01	0.10	0.00
MW-17A		20	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	3.66	0.00	0.05	0.04	0.36	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-1	9/30 - 10/6/2007	30	0.39	ND(1.0)	3.8	3.1	31.0	ND(1.0)	3.15	0.00	0.03	0.03	0.25	0.00
MW-2		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-9A		30	0.16	ND(1.0)	2.3	1.6	16.2	ND(1.0)	1.29	0.00	0.02	0.01	0.13	0.00
MW-17A		30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
								Week Totals =	4.44	0.00	0.05	0.04	0.38	0.00

Total recovered TPH-g (lbs)	Total recovered Benzene (lbs)	Total recovered Toluene (lbs)	Total recovered Ethylbenzene (lbs)	Total recovered Xylenes (lbs)	Total recovered MTBE
25.69	0.00	0.49	0.14	1.32	0.00

TABLE 3C
Soil Vapor Extraction Totals
WEEKLY SUMMARY OF DETECTED AND REMOVED TPH-g, BTEX, MTBE AND TAME
Sun City SoCo
Phase III

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	10/7 - 10/13/07	30	0.36	1.1	1.5	ND(1.0)	7.2	ND(1.0)	3.88	0.01	0.02	0.00	0.08	0.00
MW-21A	" "	30	ND(0.06)	ND(1.0)	ND(1.0)	ND(1.0)	ND(2.0)	ND(1.0)	0.00	0.00	0.00	0.00	0.00	0.00
MW-23A	" "	30	0.5	ND(1.0)	2.8	ND(1.0)	8.0	ND(1.0)	5.38	0.00	0.03	0.00	0.09	0.00
							WEEK TOTALS =		9.26	0.01	0.05	0.00	0.16	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	10/14 - 10/20/07	30	0.23	0.72	2.9	ND(1.0)	4.6	ND(1.0)	4.33	0.01	0.05	0.00	0.09	0.00
MW-21A	" "	30	0.07	1.4	5.8	ND(1.0)	3.5	ND(1.0)	1.32	0.03	0.11	0.00	0.07	0.00
MW-23A	" "	30	0.37	1.4	4.5	ND(1.0)	4.4	ND(1.0)	6.97	0.03	0.08	0.00	0.08	0.00
							WEEK TOTALS =		12.62	0.07	0.25	0.00	0.24	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	10/21 - 10/27/07	30	2.0	7.3	29	4.1	24.3	ND(1.0)	37.60	0.14	0.55	0.08	0.46	0.00
MW-21A	" "	30	1.2	3.8	22	5.0	23.0	ND(1.0)	22.61	0.07	0.41	0.09	0.43	0.00
MW-23A	" "	30	2.3	5.1	33	6.3	37.5	ND(1.0)	43.33	0.10	0.62	0.12	0.71	0.00
							WEEK TOTALS =		103.62	0.30	1.58	0.29	1.60	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	10/28 - 11/3/07	30	0.78	2.7	17	2.5	24.9	ND(1.0)	14.69	0.05	0.32	0.05	0.47	0.00
MW-21A	" "	30	0.07	ND(1.0)	1.7	ND(1.0)	ND(2.0)	ND(1.0)	1.32	0.00	0.03	NS	NS	0.00
MW-23A	" "	30	0.98	1.2	11	1.5	16.1	ND(1.0)	18.46	0.02	0.21	0.03	0.27	0.00
							WEEK TOTALS =		34.48	0.07	0.56	0.08	0.73	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	11/4 - 11/10/07	30	1.1	2.9	13	1.4	11.2	ND(1.0)	20.72	0.05	0.24	0.03	0.21	0.00
MW-21A	" "	30	0.70	1.1	9.7	1.9	9.6	ND(1.0)	13.19	0.02	0.18	0.04	0.18	0.00
MW-23A	" "	30	2.4	2.7	18	1.7	13.6	ND(1.0)	45.21	0.05	0.34	0.03	0.26	0.00
							WEEK TOTALS =		79.13	0.13	0.77	0.09	0.65	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	11/11 - 11/17/07	30	0.68	1.8	15	2.4	23.2	ND(1.0)	12.81	0.03	0.28	0.05	0.44	0.00
MW-21A	" "	30	0.18	ND(1.0)	5.0	2.2	10.2	ND(1.0)	3.39	0.00	0.09	0.04	0.19	0.00
MW-23A	" "	30	1.6	1.4	15	1.7	18.8	ND(1.0)	30.14	0.03	0.28	0.03	0.35	0.00
							WEEK TOTALS =		46.35	0.06	0.66	0.12	0.98	0.00

TABLE 3C
Soil Vapor Extraction Totals
WEEKLY SUMMARY OF DETECTED AND REMOVED TPH-g, BTEX, MTBE AND TAME
Sun City SoCo
Phase III

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	11/18 - 11/24/07	30	0.64	1.6	16	2.9	39.0	ND(1.0)	5.17	0.01	0.13	0.02	0.31	0.00
MW-21A	" "	30	0.14	ND(1.0)	4.6	1.4	11.2	ND(1.0)	1.13	0.00	0.04	0.01	0.09	0.00
MW-23A	" "	30	1.8	1.8	20	4.2	70.0	ND(1.0)	14.53	0.01	0.16	0.03	0.57	0.00
								WEEK TOTALS =	20.83	0.03	0.33	0.07	0.97	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	11/25 - 12/1/07	30	0.25	ND(1.0)	3.3	ND(1.0)	ND(2.0)	ND(1.0)	2.69	0.00	0.04	0.00	0.00	0.00
MW-21A	" "	30	2.7	2.8	15	1.3	7.2	ND(1.0)	29.07	0.00	0.16	0.01	0.08	0.00
MW-23A	" "	30	5.4	11	47.0	5.7	76.0	ND(1.0)	58.13	0.12	0.51	0.06	0.82	0.00
								WEEK TOTALS =	89.89	0.12	0.70	0.08	0.90	0.00

Well	Date by Week	Average Flow Rate (CFM)	TPH-g (mg/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Xylenes (ug/L)	MTBE (ug/L)	Recovered TPH-g (lbs)	Recovered Benzene (lbs)	Recovered Toluene (lbs)	Recovered Ethylbenzene (lbs)	Recovered Xylenes (lbs)	Recovered MTBE (lbs)
MW-10A	12/2 - 12/8/07	30	1.2	2.3	23	4.2	50	ND(1.0)	6.46	0.01	0.12	0.02	0.27	0.00
MW-21A	" "	30	0.32	ND(1.0)	8.8	2.3	14.3	ND(1.0)	1.72	0.00	0.05	0.01	0.08	0.00
MW-23A	" "	30	1.5	1.5	18	4.1	56	ND(1.0)	8.07	0.01	0.10	0.02	0.30	0.00
								WEEK TOTALS =	16.26	0.02	0.27	0.06	0.65	0.00

Total recovered TPH-g (lbs.)	Total recovered Benzene (lbs.)	Total recovered Toluene (lbs.)	Total recovered Ethylbenzene (lbs.)	Total recovered Xylenes (lbs.)
412.42	0.80	5.16	0.78	6.88

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